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Yoo et al.

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(54) **DIGITAL BROADCASTING SYSTEM AND METHOD OF PROCESSING DATA IN THE DIGITAL BROADCASTING SYSTEM**

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(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1068 days.

(21) Appl. No.: **12/197,130**

(22) Filed: **Aug. 22, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/957,714, filed on Aug. 24, 2007, provisional application No. 60/974,084, filed on Sep. 21, 2007, provisional application No. 60/977,379, filed on Oct. 4, 2007, provisional application No. 61/044,504, filed on Apr. 13, 2008, provisional application No. 61/076,686, filed on Jun. 29, 2008.

(30) **Foreign Application Priority Data**

Aug. 22, 2008 (KR) 10-2008-0082586

(51) **Int. Cl.**

H04N 7/16	(2011.01)
H04N 7/20	(2006.01)
H04H 20/71	(2008.01)
H04H 20/74	(2008.01)
H04M 11/00	(2006.01)
H04B 7/185	(2006.01)

(52) **U.S. Cl.** **725/62**; 725/63; 455/3.01; 455/3.02; 455/403; 370/312; 375/316

(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

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(57) **ABSTRACT**

A digital broadcasting system and a data processing method are disclosed. A receiving system of the digital broadcast system includes a mobile service data processor, a main service data processor, a controller, and a display module. The mobile service data processor receives mobile service data through a mobile service data path. Herein, the mobile service data configures an RS frame, and the RS frame includes mobile service data including a mobile A/V broadcast signal and at least one channel configuration information on the mobile service data. The main service data processor receives main service data through a main service data path. Herein, the main service data includes a main A/V broadcast signal and a program guide information of the main A/V broadcast. The controller extracts a link information for the program guide service of the mobile A/V broadcast signal from the channel configuration information, and acquires a corresponding program guide information from the main service data processor by using the extracted link information. And, the display module outputs the program guide information acquired from the controller to a display screen.

17 Claims, 26 Drawing Sheets

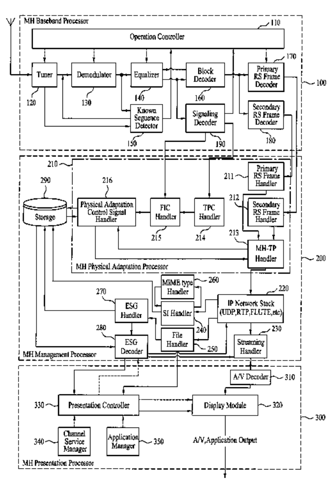
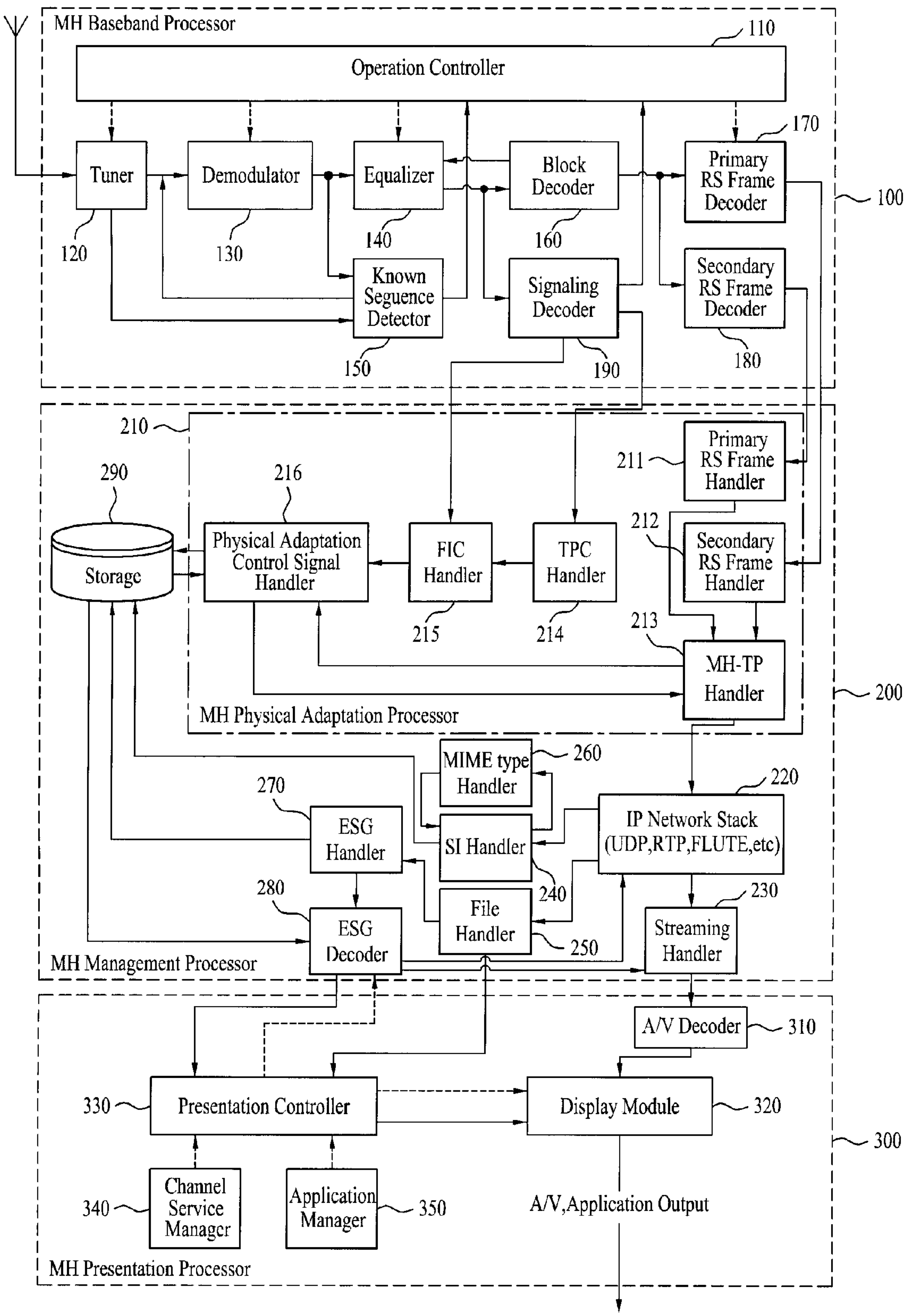


FIG. 1



MH Baseband Processor
110
Operation Controller
170
Tuner
Demodulator
Equalizer
Block Decoder
Primary RS Frame Decoder
100
120
130
140
160
Known Seguence Detector
Signaling Decoder
Secondary RS Frame Decoder
150
190
180
210
290
216
211
Primary RS Frame Handler
212
Storage
Physical Adaptation Control Signal Handler
FIC Handler
TPC Handler
Secondary RS Frame Handler
215
214
213
MH-TP Handler
200
MH Physical Adaptation Processor
MIME type Handler
260
270
220
ESG Handler
SI Handler
IP Network Stack (UDP,RTP,FLUTE,etc)
280
240
230
ESG Decoder
File Handler
250
Streaming Handler
MH Management Processor
A/V Decoder
310
330
Presentation Controller
Display Module
320
300
340
Channel Service Manager
Application Manager
350
A/V,Application Output
MH Presentation Processor

FIG. 2

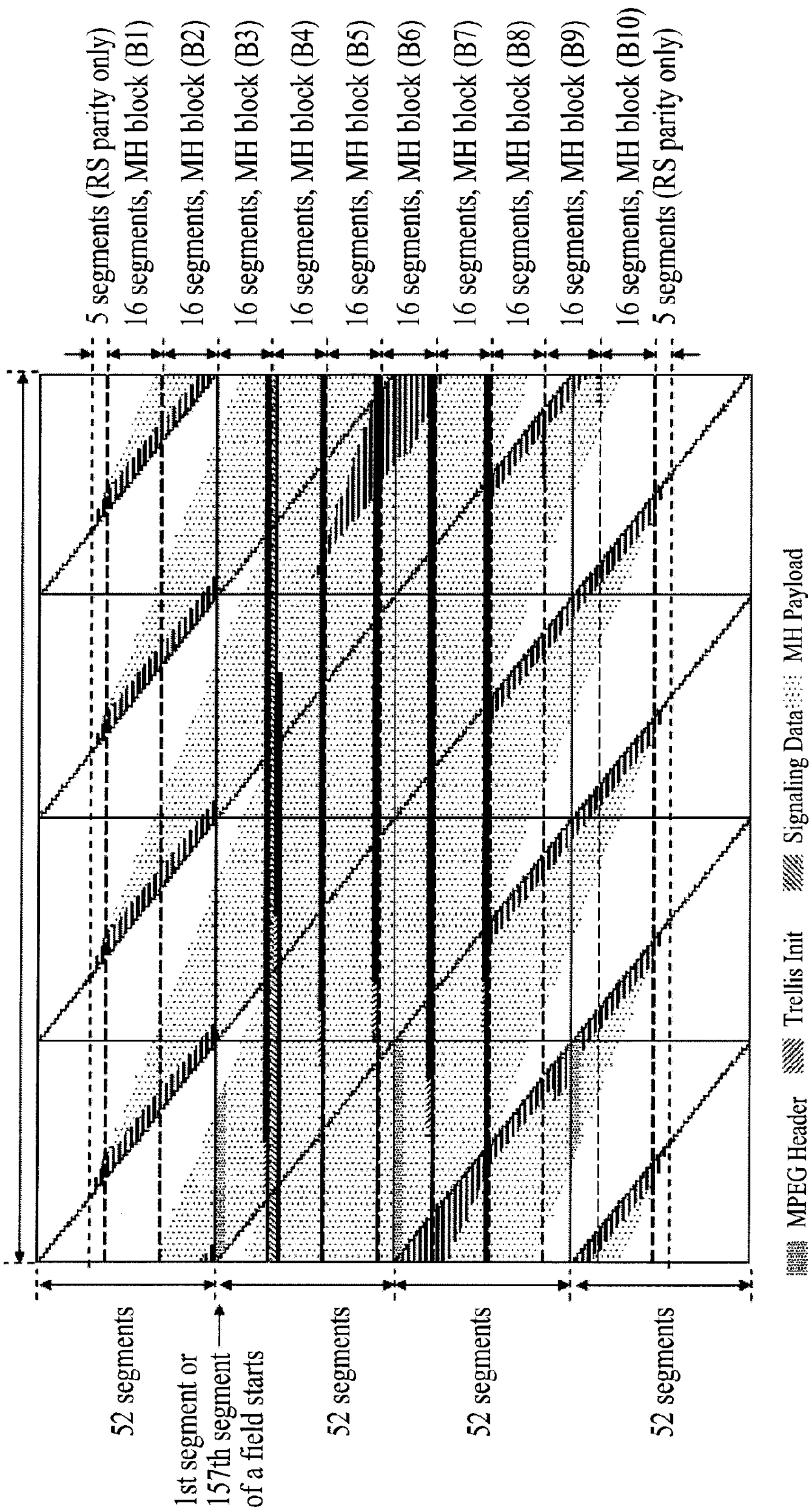

5 segments (RS parity only)
16 segments, MH block (B1)
16 segments, MH block (B2)
16 segments, MH block (B3)
16 segments, MH block (B4)
16 segments, MH block (B5)
16 segments, MH block (B6)
16 segments, MH block (B7)
16 segments, MH block (B8)
16 segments, MH block (B9)
16 segments, MH block (B10)
5 segments (RS parity only)
52 segments
1st segment or 157th segment of a field starts
52 segments
52 segments
52 segments
MPEG Header
RS parity
Trellis Init
Known Data
Signaling Data
Dummy Data
MH Payload

FIG. 3

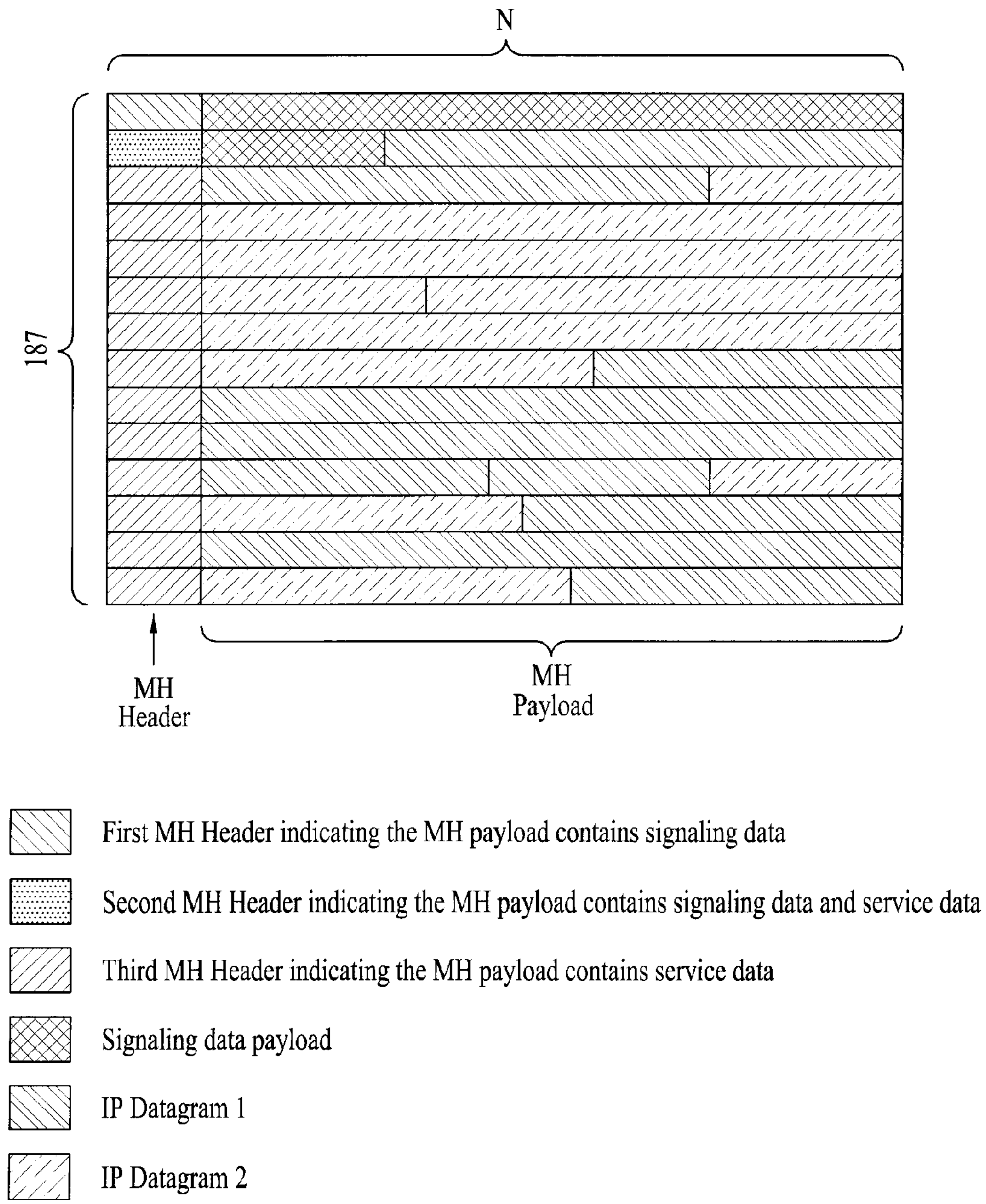

N
187
MH
Header
MH
Payload
First MH Header indicating the MH payload contains signaling data
Second MH Header indicating the MH payload contains signaling data and service data
Third MH Header indicating the MH payload contains service data
Signaling data payload
IP Datagram 1
IP Datagram 2

FIG. 4

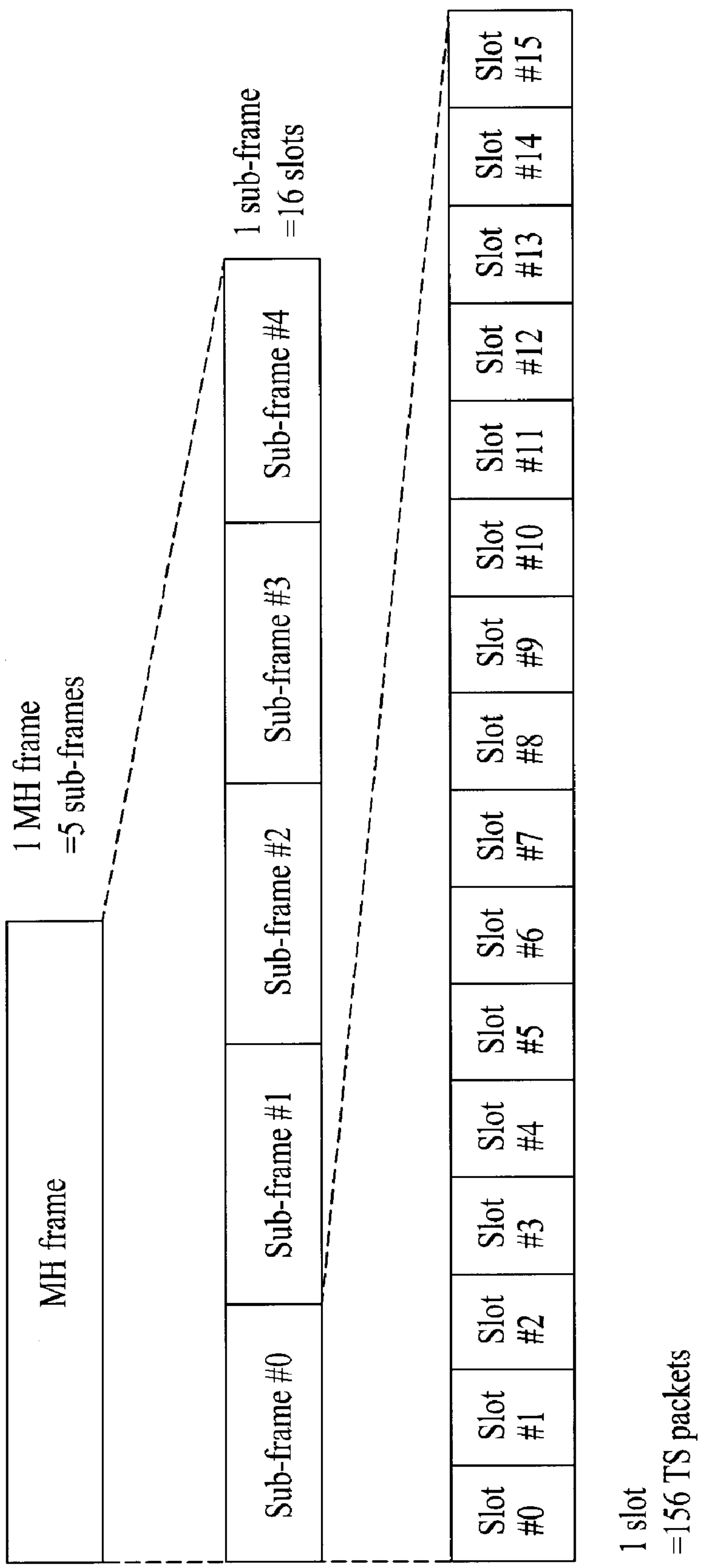

MH frame
1 MH frame
=5 sub-frames
Sub-frame #0
Sub-frame #1
Sub-frame #2
Sub-frame #3
Sub-frame #4
1 sub-frame
=16 slots
Slot #0
Slot #1
Slot #2
Slot #3
Slot #4
Slot #5
Slot #6
Slot #7
Slot #8
Slot #9
Slot #10
Slot #11
Slot #12
Slot #13
Slot #14
Slot #15
1 slot
=156 TS packets

FIG. 5

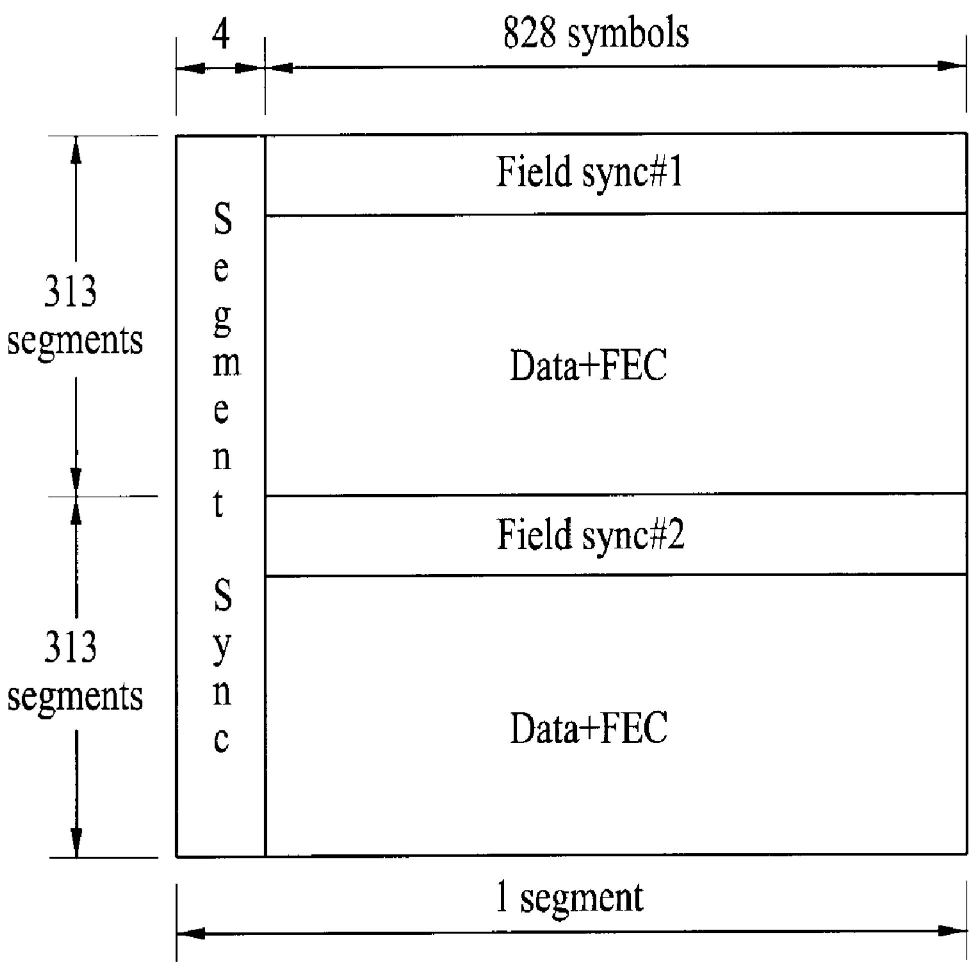
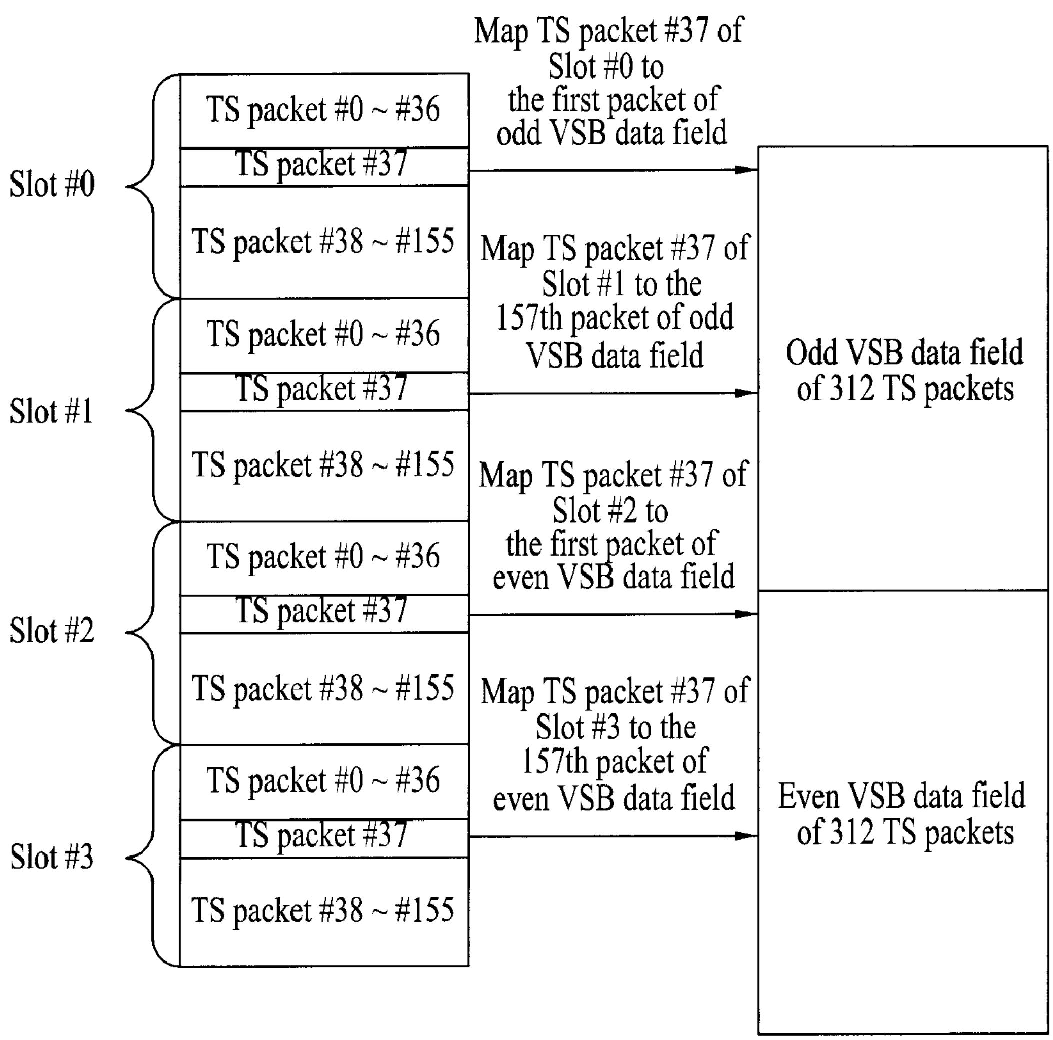

4
828 symbols
313
segments
313
segments
Segment Sync
Field sync#1
Data+FEC
Field sync#2
Data+FEC
1 segment

FIG. 6



Map TS packet #37 of Slot #0 to the first packet of odd VSB data field
Slot #0
TS packet #0 ~ #36
TS packet #37
TS packet #38 ~ #155
Map TS packet #37 of Slot #1 to the 157th packet of odd VSB data field
Slot #1
TS packet #0 ~ #36
TS packet #37
TS packet #38 ~ #155
Map TS packet #37 of Slot #2 to the first packet of even VSB data field
Slot #2
TS packet #0 ~ #36
TS packet #37
TS packet #38 ~ #155
Map TS packet #37 of Slot #3 to the 157th packet of even VSB data field
Slot #3
TS packet #0 ~ #36
TS packet #37
TS packet #38 ~ #155
Odd VSB data field of 312 TS packets
Even VSB data field of 312 TS packets

FIG. 7

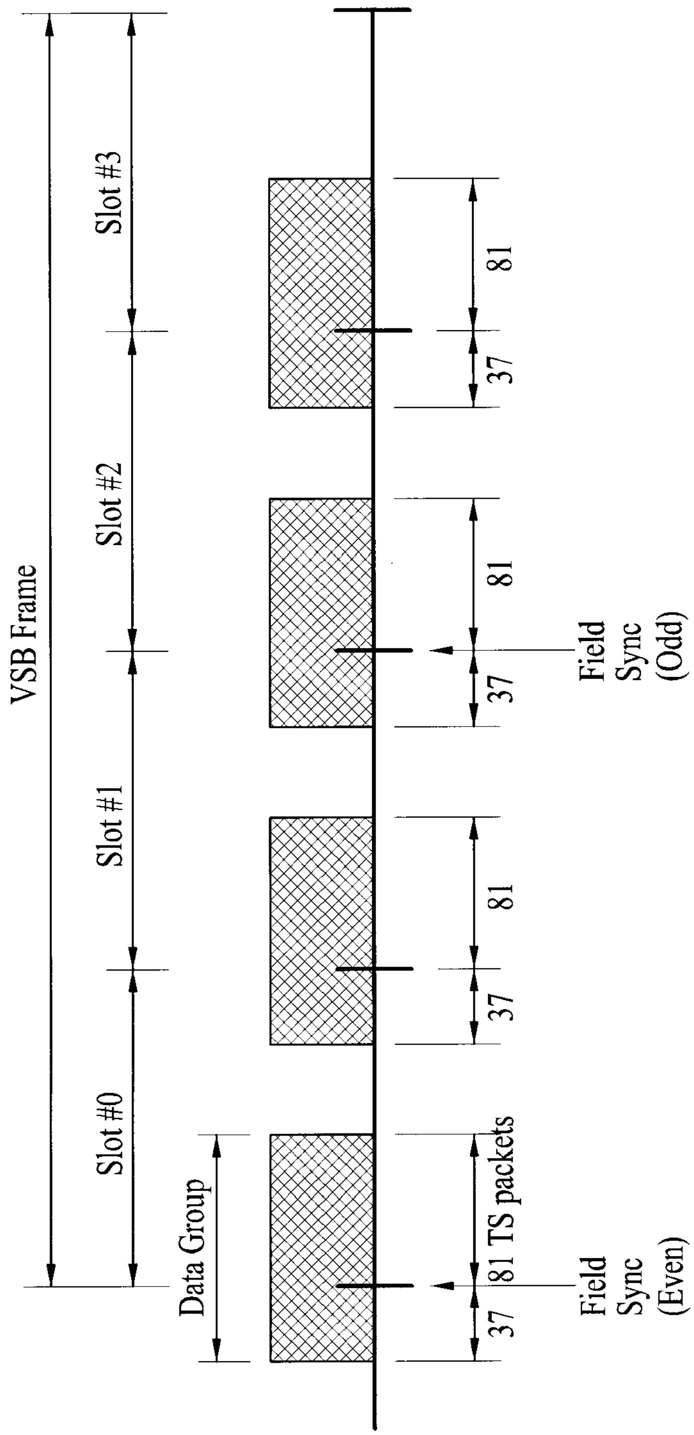

VSB Frame
Slot #0
Slot #1
Slot #2
Slot #3
Data Group
81 TS packets
37
81
37
81
37
81
37
Field Sync (Even)
Field Sync (Odd)

FIG. 8

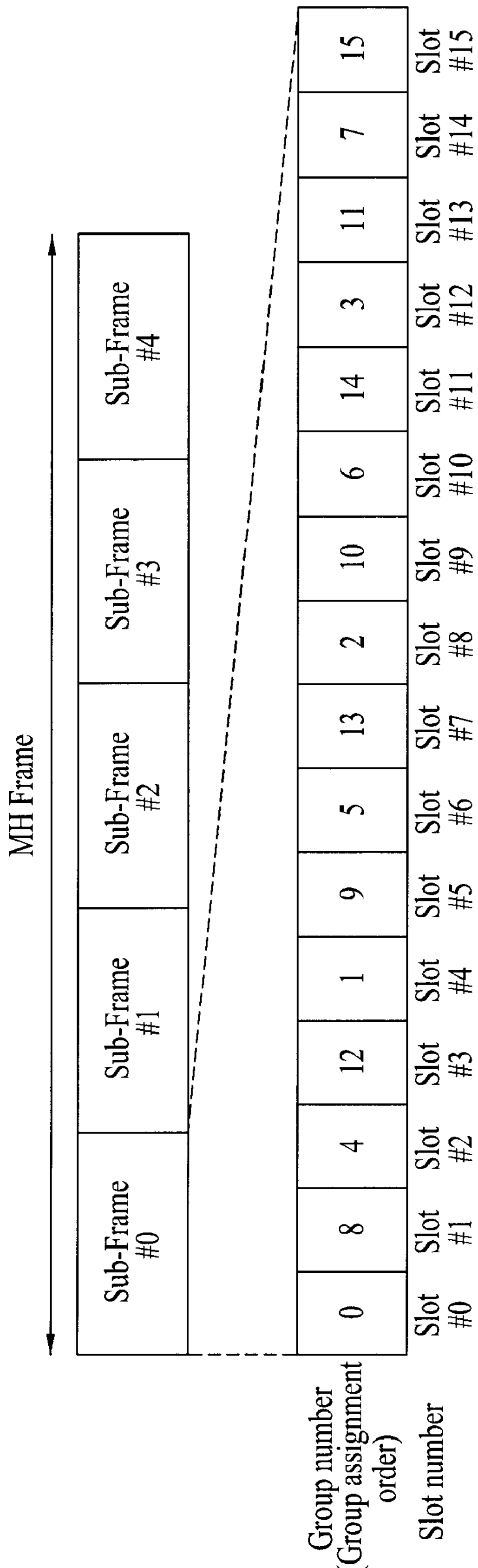

MH Frame
Sub-Frame #0
Sub-Frame #1
Sub-Frame #2
Sub-Frame #3
Sub-Frame #4
Group number (Group assignment order)
0
8
4
12
1
9
5
13
2
10
6
14
3
11
7
15
Slot number
Slot #0
Slot #1
Slot #2
Slot #3
Slot #4
Slot #5
Slot #6
Slot #7
Slot #8
Slot #9
Slot #10
Slot #11
Slot #12
Slot #13
Slot #14
Slot #15

FIG. 9

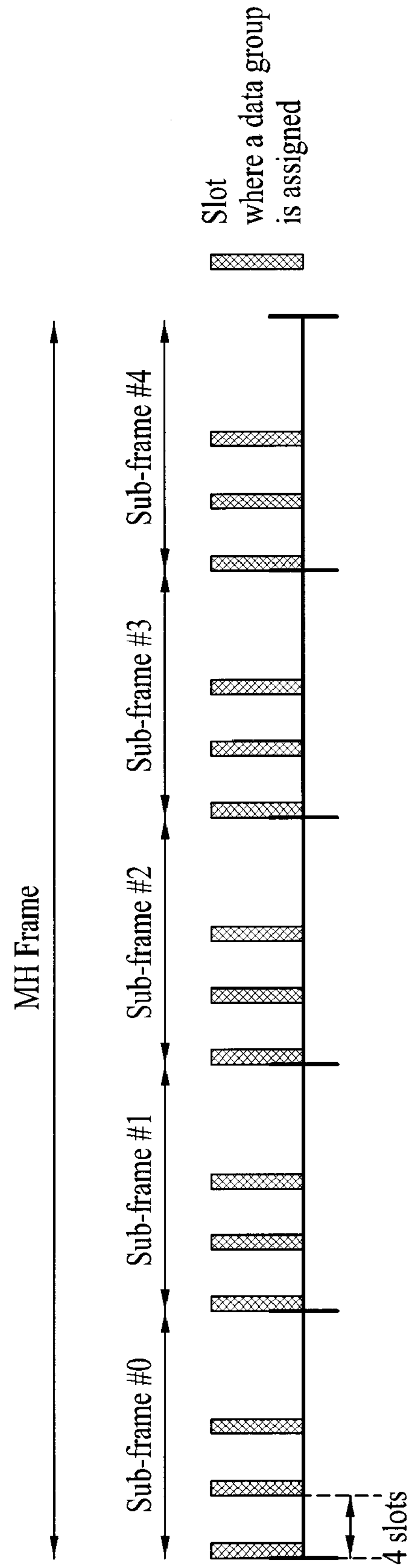
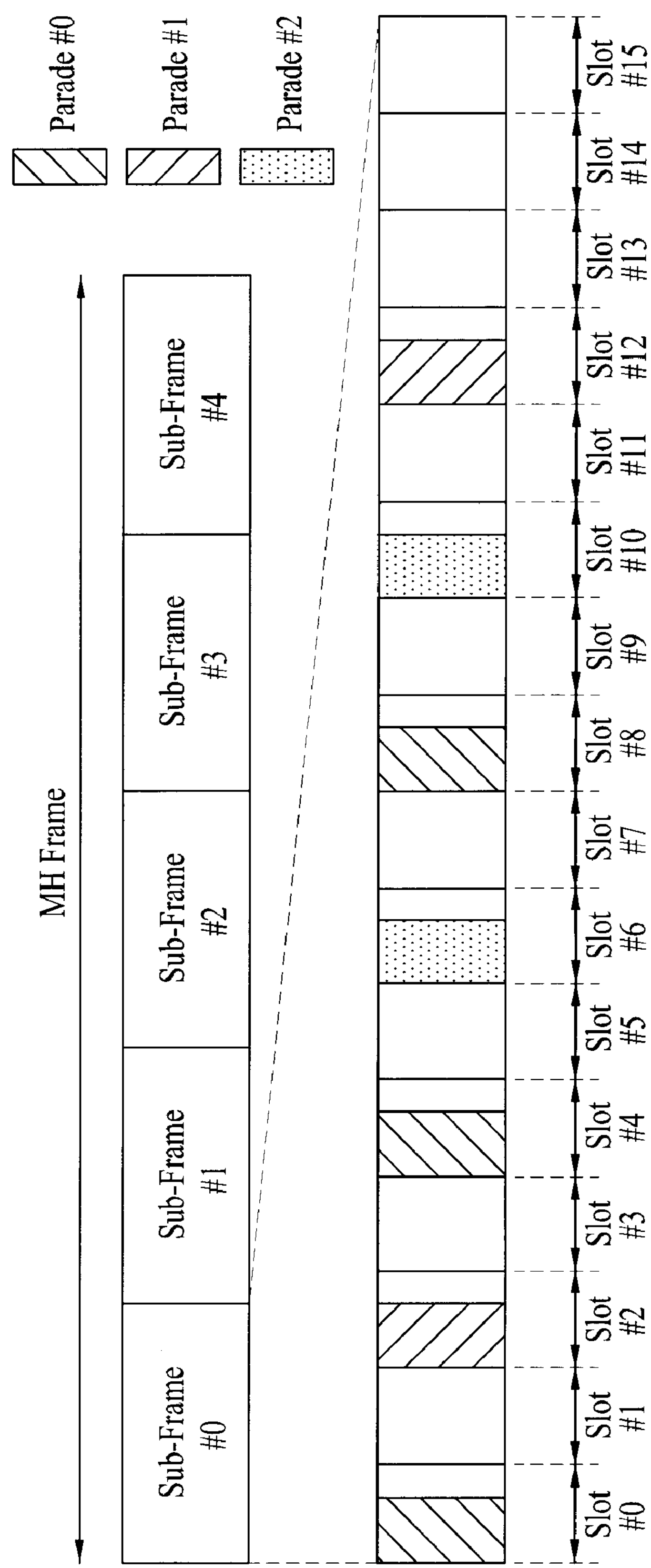

Slot
where a data group
is assigned
MH Frame
Sub-frame #0
Sub-frame #1
Sub-frame #2
Sub-frame #3
Sub-frame #4
4 slots

FIG. 10



Parade #0
Parade #1
Parade #2
MH Frame
Sub-Frame #0
Sub-Frame #1
Sub-Frame #2
Sub-Frame #3
Sub-Frame #4
Slot #0
Slot #1
Slot #2
Slot #3
Slot #4
Slot #5
Slot #6
Slot #7
Slot #8
Slot #9
Slot #10
Slot #11
Slot #12
Slot #13
Slot #14
Slot #15

FIG. 11

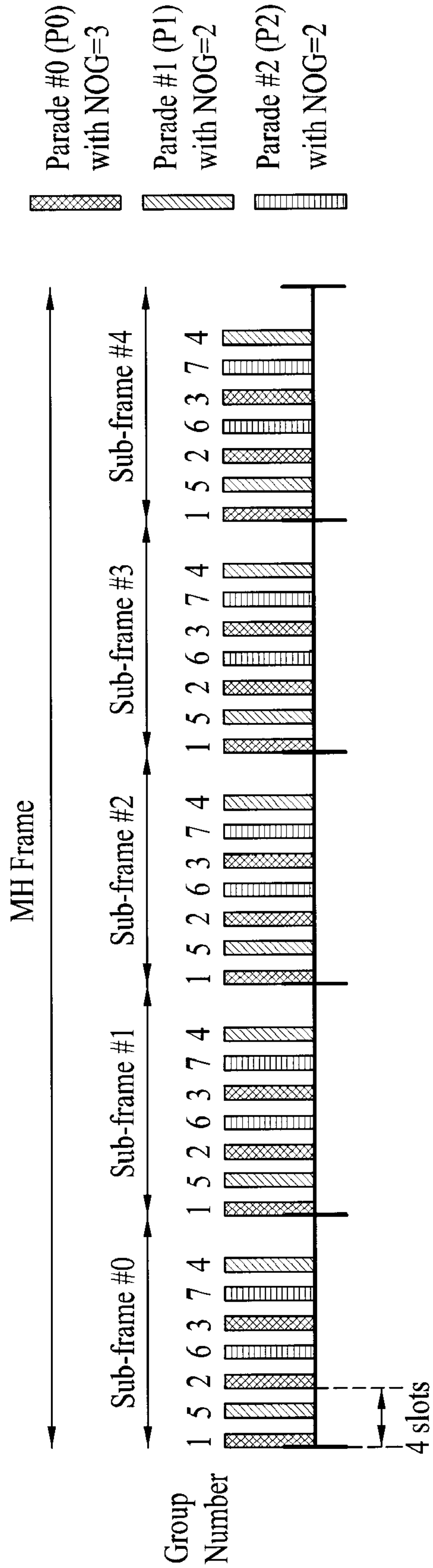

Parade #0 (P0)
with NOG=3
Parade #1 (P1)
with NOG=2
Parade #2 (P2)
with NOG=2
MH Frame
Sub-frame #0
Sub-frame #1
Sub-frame #2
Sub-frame #3
Sub-frame #4
Group
Number
1 5 2 6 3 7 4
1 5 2 6 3 7 4
1 5 2 6 3 7 4
1 5 2 6 3 7 4
1 5 2 6 3 7 4
4 slots

FIG. 12

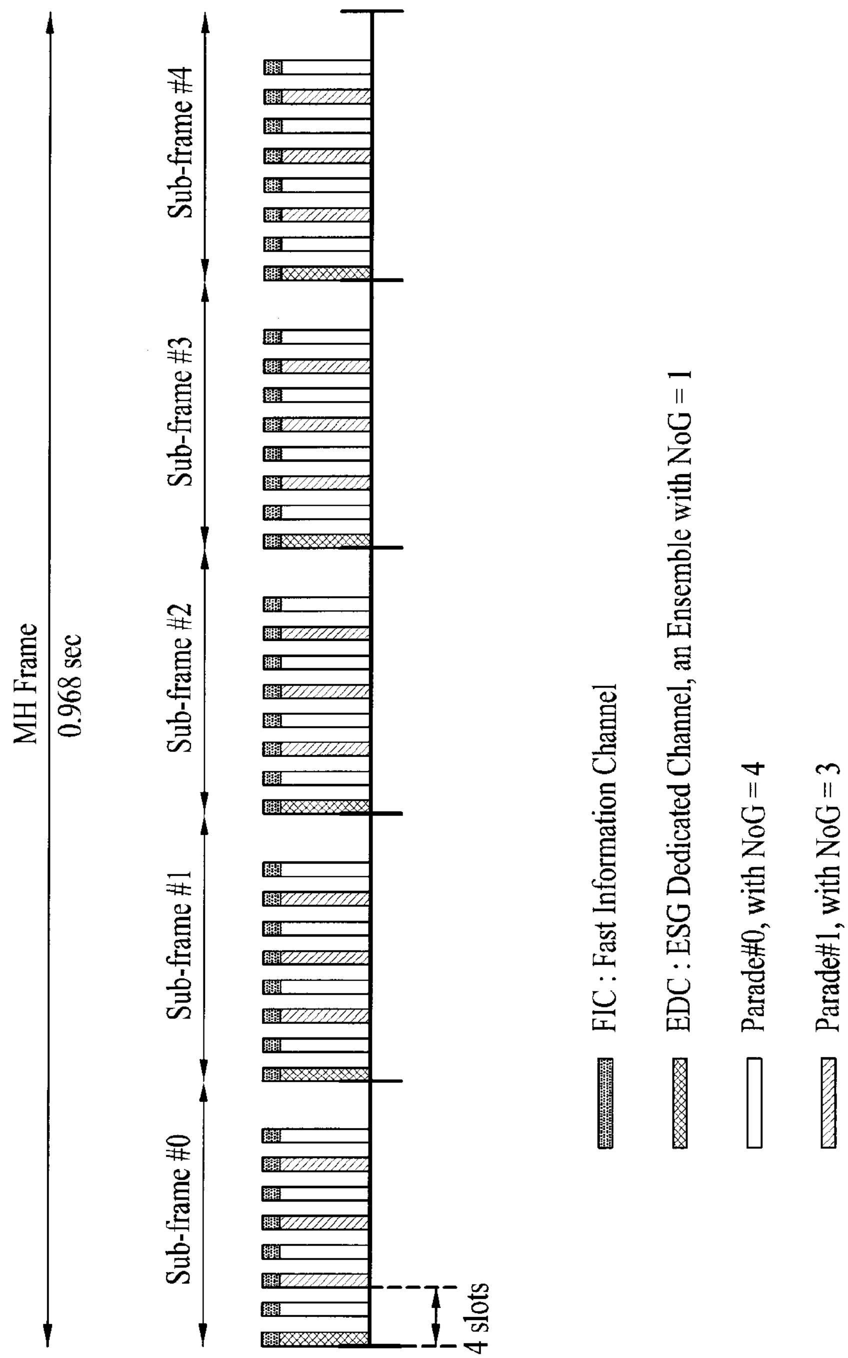

MH Frame
0.968 sec
Sub-frame #0
Sub-frame #1
Sub-frame #2
Sub-frame #3
Sub-frame #4
4 slots
FIC : Fast Information Channel
EDC : ESG Dedicated Channel, an Ensemble with NoG = 1
Parade#0, with NoG = 4
Parade#1, with NoG = 3

FIG. 13

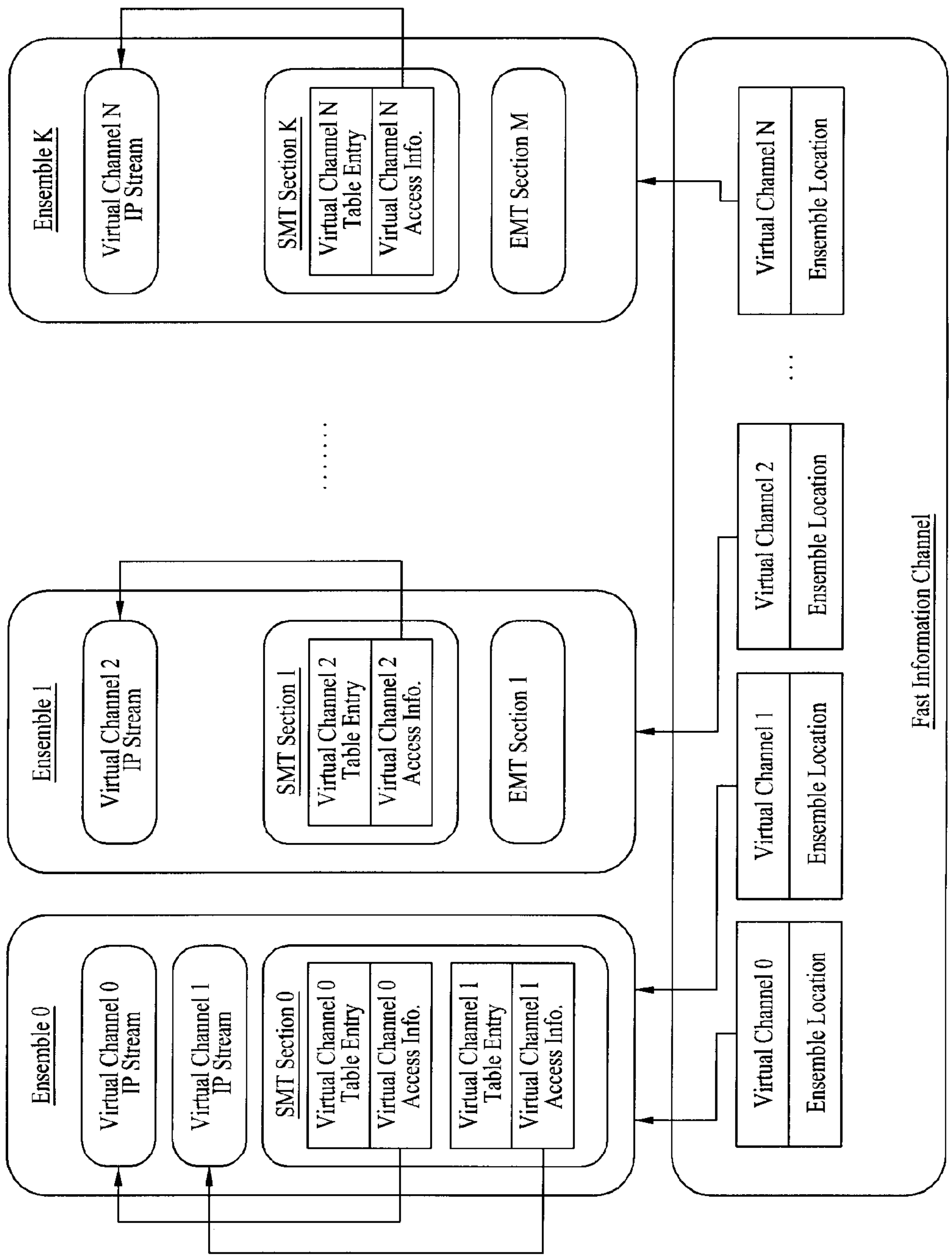

Ensemble 0
Virtual Channel 0 IP Stream
Virtual Channel 1 IP Stream
SMT Section 0
Virtual Channel 0 Table Entry
Virtual Channel 0 Access Info.
Virtual Channel 1 Table Entry
Virtual Channel 1 Access Info.
Ensemble 1
Virtual Channel 2 IP Stream
SMT Section 1
Virtual Channel 2 Table Entry
Virtual Channel 2 Access Info.
EMT Section 1
Ensemble K
Virtual Channel N IP Stream
SMT Section K
Virtual Channel N Table Entry
Virtual Channel N Access Info.
EMT Section M
Virtual Channel 0
Ensemble Location
Virtual Channel 1
Ensemble Location
Virtual Channel 2
Ensemble Location
Virtual Channel N
Ensemble Location
Fast Information Channel

FIG. 14

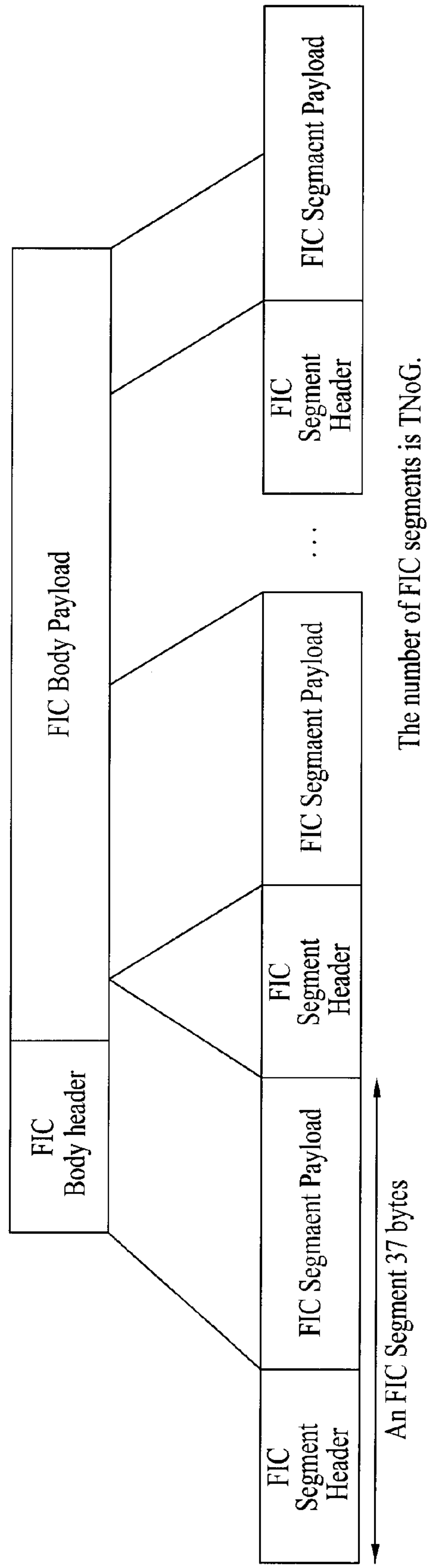

FIC Body header
FIC Body Payload
FIC Segment Header
FIC Segmaent Payload
FIC Segment Header
FIC Segmaent Payload
...
FIC Segment Header
FIC Segmaent Payload
An FIC Segment 37 bytes
The number of FIC segments is TNoG.

FIG. 15

Syntax	# of bits
FIC_Segment () {	
FIC_type	2
Reserved	5
error_indicator	1
FIC_seg_number	4
FIC_last_seg_number	4
for (i=0:i<N:i++) {	
data_byte	8
}	
}	

FIG. 16

	Syntax	# of bits
A first region	if (FIC_seg_number == 0) {	
	current_next_indicator	1
	Reserved	2
	ESG_version	5
	transport_stream_id	16
	}	
A second region	while (ensemble_id ! = 0xFF)	
	ensemble id	8
	reserved	3
	SI_version	5
	num_channcl	3
A third region	for (i=0:i< num_channel:i++) {	
	channel_type	5
	channel_activity	2
	CA_indicator	1
	Stand_alone_Semce_indtcator	
	major_channel_num	8
	minor_channel_num	8
	}	
	} // end of while	
}		

FIG. 17

Syntax	No. of Bits	Format
service_map_table_section() {		
table_id	8	TBD
section_syntax_indicator	1	'0'
private_indicator	1	'1'
reserved	2	'11'
section_length	12	uimsbf
reserved	3	'111'
version_number	5	uimsbf
section_number	8	uimsbf
last_section_number	8	uimsbf
SMT_protocol_version	8	uimsbf
ensemble_id	8	uimsbf
num_channels	8	uimsbf
for (i=0; i<num_channels; i++)		
{		
major_channel_number	8	uimsbf
minor_channel_number	8	uimsbf
short_channel_name	8*8	
service_id	16	uimsbf
service_type	6	uimsbf
virtual_channel_activity	2	uimsbf
num_components	5	uimsbf
IP_version_flag	1	bslbf
source_IP_address_flag	1	bslbf
virtual_channel_target_IP_address_flag	1	bslbf
if (source_IP_address_flag)		
source_IP_address	32 or 128	uimsbf
if (virtual_channel_target_IP_address_flag)		
virtual_channel_target_IP_address	32 or 128	uimsbf
EMT_activity_flag	1	bslbf
for (j=0; j<num_components; j-+)		
{		
RTP_payload_type	7	uimsbf
component_target_IP_address _flag	1	bslbf
if (component_target_IP_address _flag)		
component_target_IP_address	32 or 128	uimsbf
reserved	2	'11'
port_num_count	6	uimsbf
target_UDP_port_num	16	uimsbf
descriptors_length	8	uimsbf
for (k=0; k<descriptors_length; k++)		
{		
component_level_descriptor()		
}		
}		
descriptors_length	8	uimsbf
for (m=0; m<descriptors_length; m++)		
{		
virtual_channel_level_descriptor()		
}		
}		
descriptors_length	8	uimsbf
for (n=0; n<descriptors_length; n++) {		
{		
ensemble_level_descriptor()		
}		
}		

FIG. 18

Syntax	No. of Bits	Format
MH_audio_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
channel_configuration	8	uimsbf
reserved	5	'11111'
sample_rate_code	3	uimsbf
reserved	2	'11'
bit_rate_code	6	uimsbf
ISO_639_language_code	3*8	uimsbf
}		

FIG. 19

Syntax	No. of Bits	Format
MH_RTP_payload_type_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
reserved	1	'1'
RTP_payload_type	7	uimsbf
MIME_type_length	8	uimsbf
MIME_type()	var	
}		

FIG. 20

Syntax	No. of Bits	Format
MH_current_event_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
current_event_start_time	4*8	uimsbf
current_event_duration	3*8	uimsbf
Title_length	8	uimsbf
Title_text()	var	
}		

FIG. 21

Syntax	No. of Bits	Format
MH_next_event_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
next_event_start_time	4*8	uimsbf
next_event_duration	3*8	uimsbf
title_length	8	uimsbf
title_text()	var	
}		

FIG. 22

Syntax	No. of Bits	Format
MH_system_time_descriptor() {		
descriptor_tag	8	TBD
dcscriptor_length	8	uimsbf
system_time	32	uimsbf
GPS_UTC_offset	8	uimsbf
time_zone_offset_polarity_rate_code	1	bslbf
time_zone_offset	31	uimsbf
daylight_savings()	16	uimsbf
time_zone()	5*8	
}		

FIG. 23

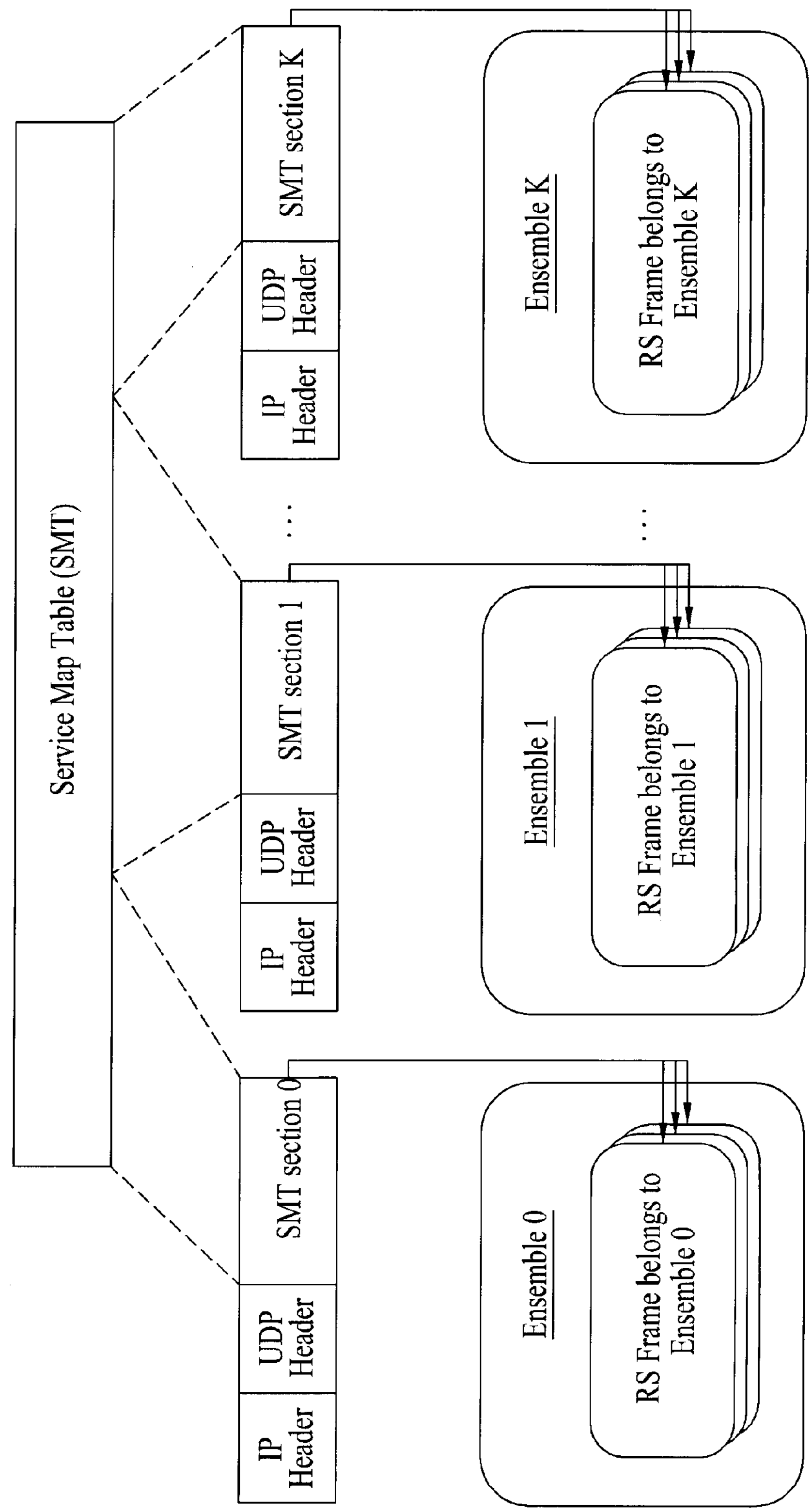

Service Map Table (SMT)
IP Header
UDP Header
SMT section 0
IP Header
UDP Header
SMT section 1
IP Header
UDP Header
SMT section K
Ensemble 0
RS Frame belongs to Ensemble 0
Ensemble 1
RS Frame belongs to Ensemble 1
Ensemble K
RS Frame belongs to Ensemble K

FIG. 24

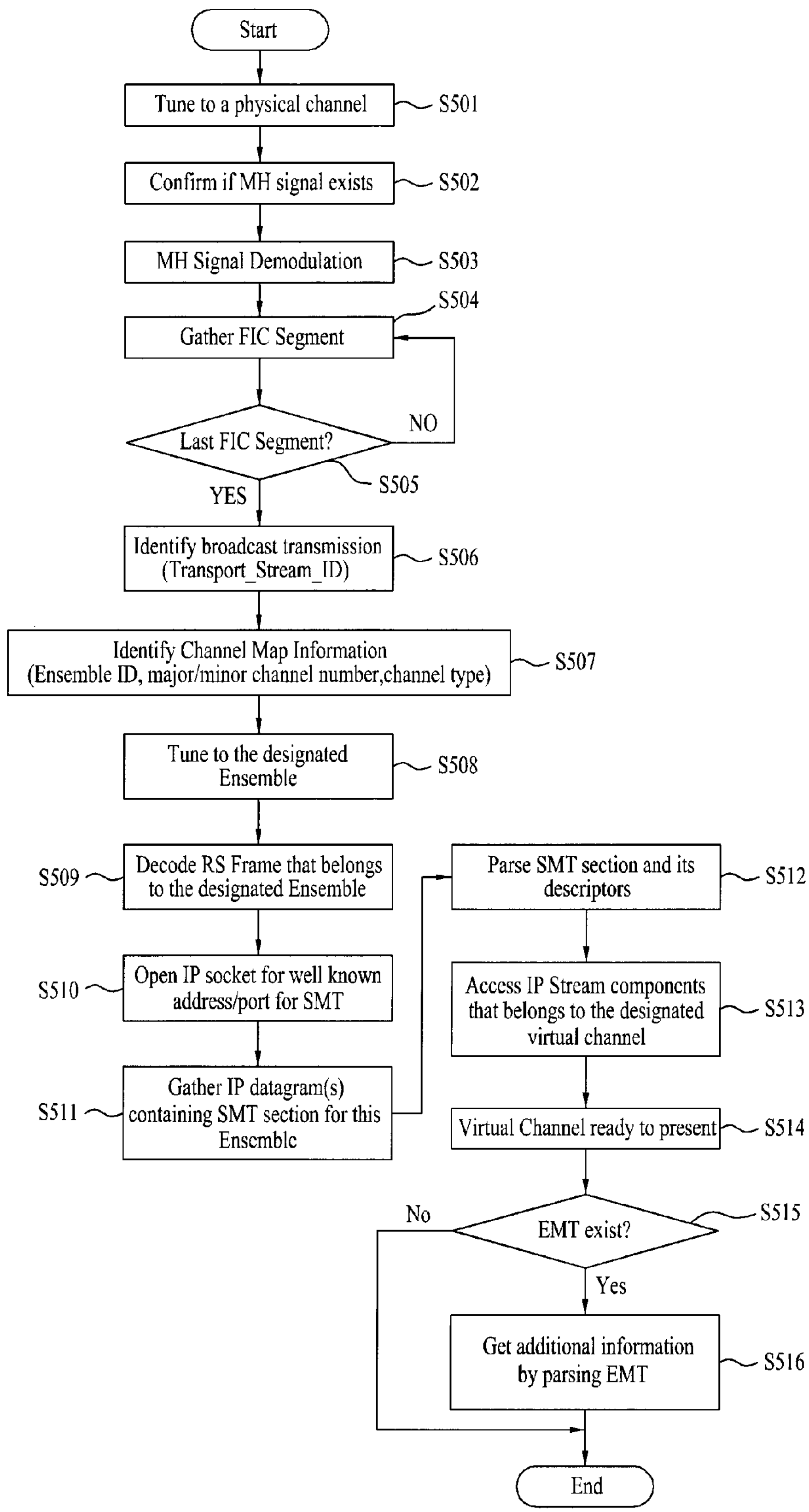

Start
Tune to a physical channel
S501
Confirm if MH signal exists
S502
MH Signal Demodulation
S503
S504
Gather FIC Segment
Last FIC Segment?
NO
S505
YES
Identify broadcast transmission (Transport_Stream_ID)
S506
Identify Channel Map Information (Ensemble ID, major/minor channel number,channel type)
S507
Tune to the designated Ensemble
S508
S509
Decode RS Frame that belongs to the designated Ensemble
S510
Open IP socket for well known address/port for SMT
S511
Gather IP datagram(s) containing SMT section for this Ensemble
Parse SMT section and its descriptors
S512
Access IP Stream components that belongs to the designated virtual channel
S513
Virtual Channel ready to present
S514
EMT exist?
S515
No
Yes
Get additional information by parsing EMT
S516
End

FIG. 25

Syntax	No. of Bits	Format
extended_service_map_table_section() {		
table_id	8	TBD
section_syntax_indicator	1	'0'
Private_indicator	1	'1'
reserved	2	'11'
section_length	12	uimsbf
transport_stream_id	16	uimsbf
reserved	2	'111'
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
EMT_protocol_version	8	uimsbf
ensemble_id	8	uimsbf
num_channels	8	uimsbf
for (i=0; i<num_channels; i++)		
{		
major_channel_number	8	uimsbf
minor_channel_number	8	uimsbf
num_components	6	uimsbf
for (j=0; j<num_components; j++)		
{		
descriptors_length	8	uimsbf
for (k=0; k<descriptor_length; k++)		
{		
component_level_descriptor()		
}		
}		
num_events	8	uimsbf
for (j=0; j<num_events; j++)		
{		
descriptors_length	8	uimsbf
for (k=0; k<descriptors_length; k++)		
{		
event_level_descriptor()		
}		
}		
descriptors_length	8	uimsbf
for (m=0; m<descriptors_length; m++)		
{		
virtual_channel_level_descriptor()		
}		
}		
descriptors_length	8	uimsbf
for (n=0; n<descriptors_length; n++)		
{		
ensemble_level_descriptor()		
}		
}		

FIG. 26

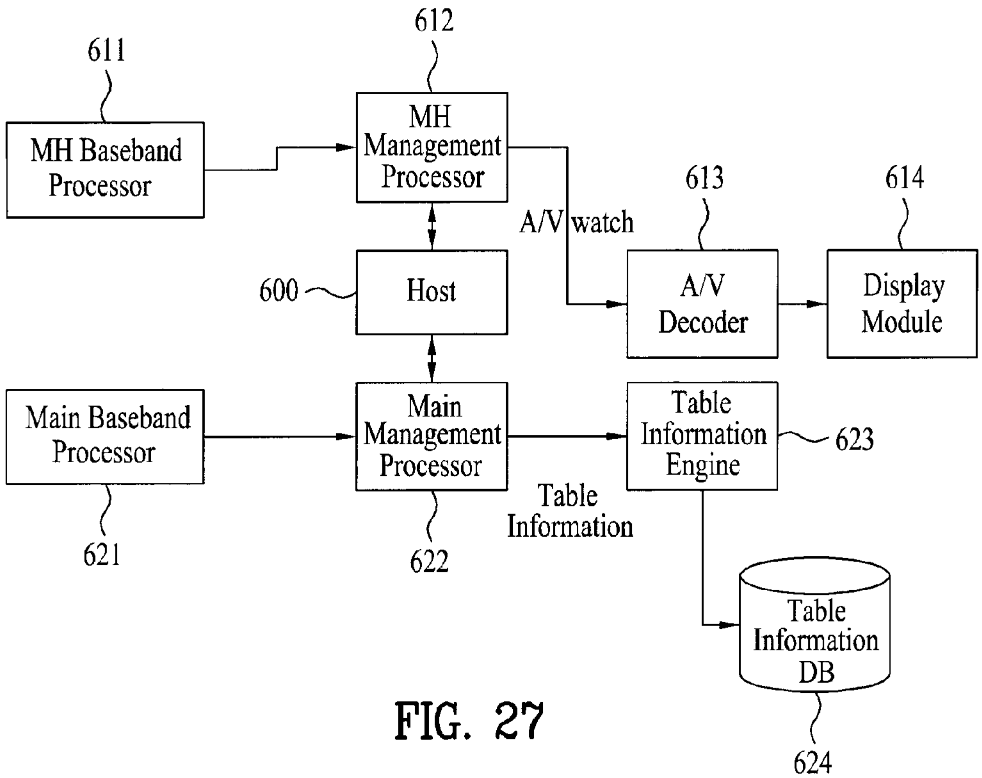


FIG. 27

Syntax	No. of Bits	Format
MH_event_information_location_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
service_type	6	uimsbf
source_id	16	uimsbf
reserved	2	uimsbf
}		

FIG. 28

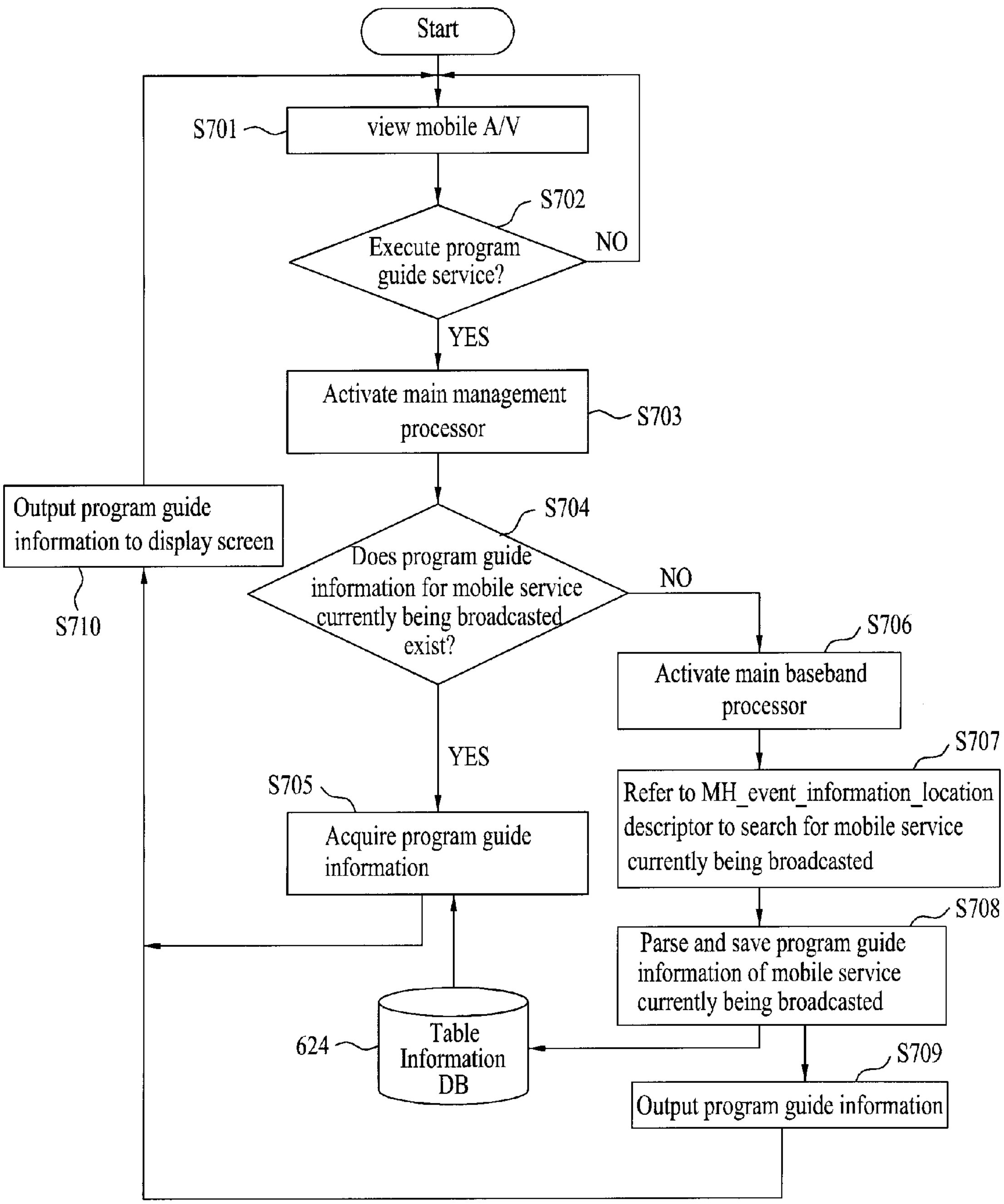
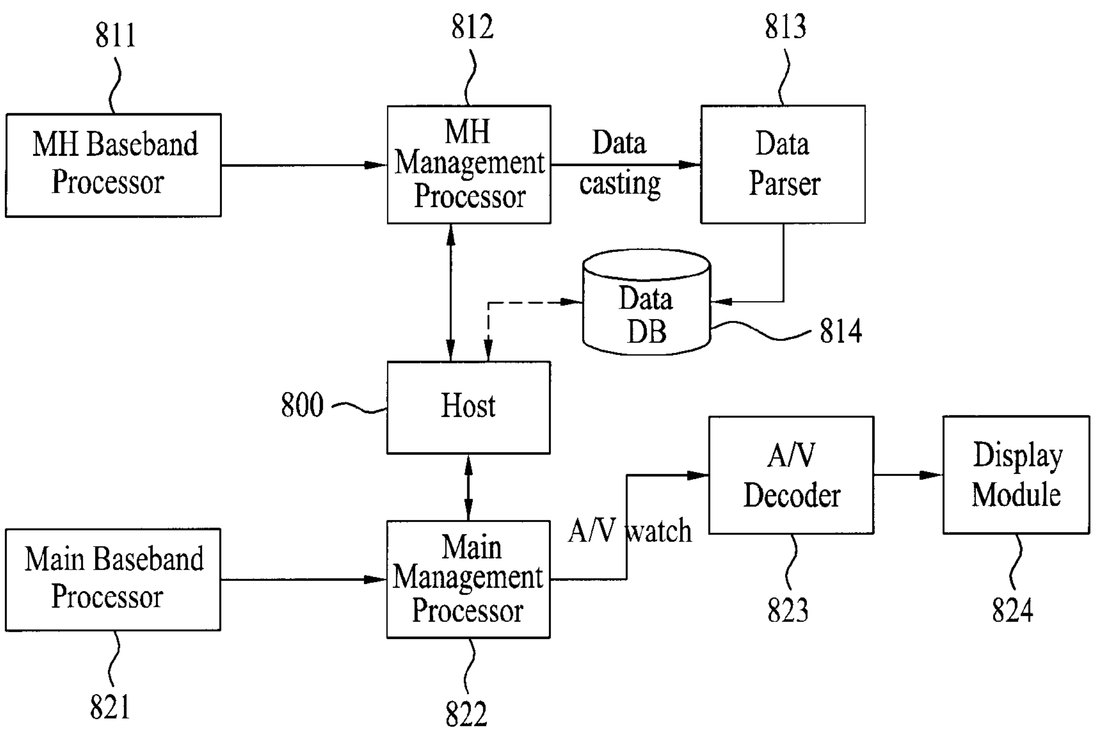

Start
S701
view mobile A/V
S702
Execute program guide service?
NO
YES
Activate main management processor
S703
S704
Does program guide information for mobile service currently being broadcasted exist?
NO
S706
Activate main baseband processor
S707
Refer to MH_event_information_location descriptor to search for mobile service currently being broadcasted
S708
Parse and save program guide information of mobile service currently being broadcasted
S709
Output program guide information
YES
S705
Acquire program guide information
624
Table Information DB
Output program guide information to display screen
S710

FIG. 29

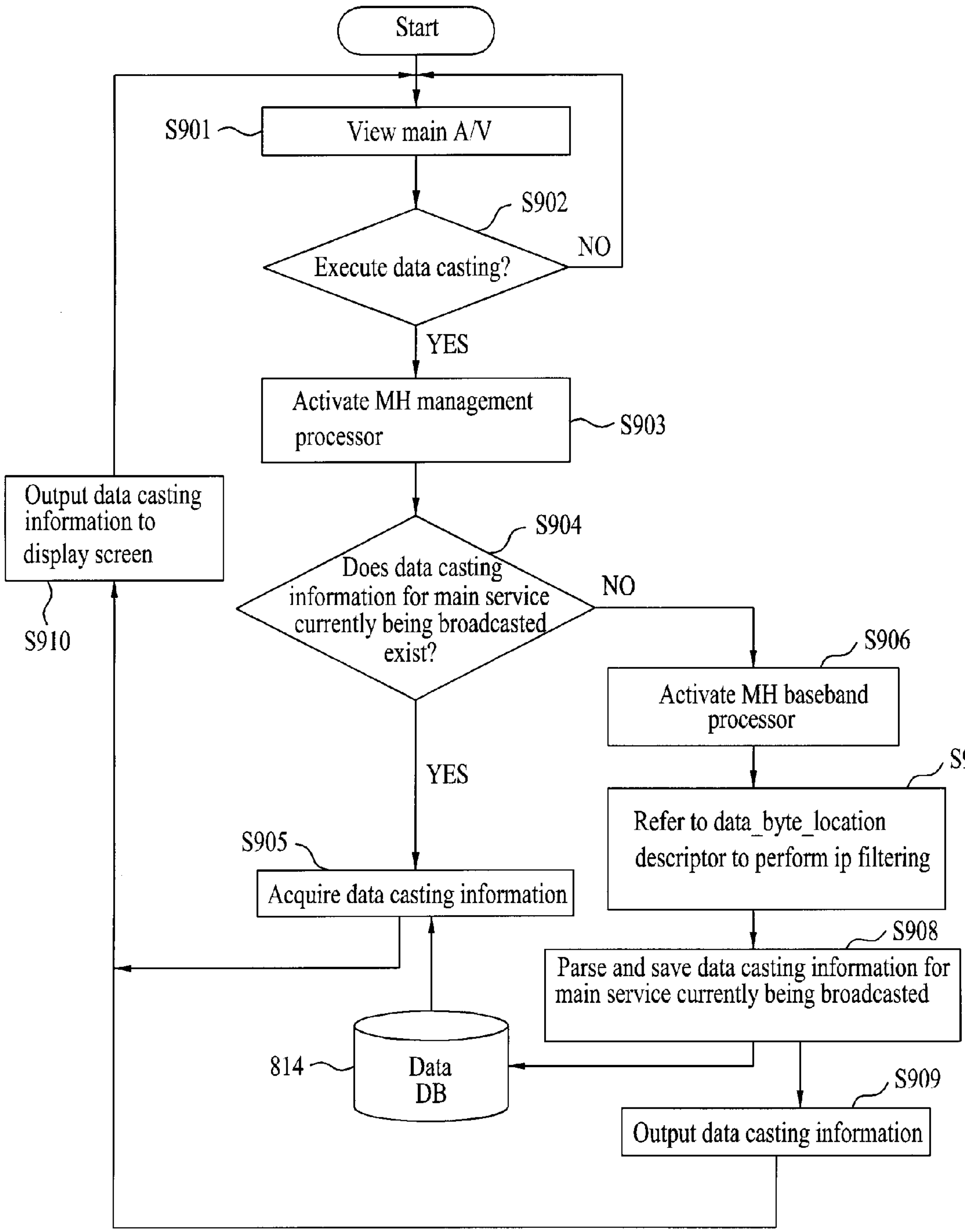


811
MH Baseband Processor
812
MH Management Processor
Data casting
813
Data Parser
Data DB
814
800
Host
Main Baseband Processor
821
Main Management Processor
822
A/V watch
A/V Decoder
823
Display Module
824

FIG. 30

Syntax	No. of Bits	Format
data_byte_location_descriptor() {		
descriptor_tag	8	TBD
descriptor_length	8	uimsbf
ensemble_id	8	uimsbf
major_channel_number	8	uimsbf
minor_channel_number	8	uimsbf
IP_version_flag	1	bslbf
source_IP_address_flag	1	bslbf
virtual_channel_target_IP_address_flag	1	bslbf
if(source_IP_adderss_flag)		
source_IP_adderss	32 or 128	uimsbf
if(virtual_channel_target_IP_address_flag)		
virtual_channel_target_IP_address	32 or 128	uimsbf
content_type	8	uimsbf
content_name	8*8	uimsbf
content_id	16	uimsbf
}		

FIG. 31


Start
S901
View main A/V
S902
Execute data casting?
NO
YES
Activate MH management processor
S903
S904
Does data casting information for main service currently being broadcasted exist?
NO
S906
Activate MH baseband processor
S907
Refer to data_byte_location descriptor to perform ip filtering
YES
S905
Acquire data casting information
S908
Parse and save data casting information for main service currently being broadcasted
814
Data DB
S909
Output data casting information
Output data casting information to display screen
S910

DIGITAL BROADCASTING SYSTEM AND METHOD OF PROCESSING DATA IN THE DIGITAL BROADCASTING SYSTEM

This application claims the benefit of U.S. Provisional Application No. 60/957,714, filed on Aug. 24, 2007, which is hereby incorporated by reference. Also, this application claims the benefit of U.S. Provisional Application No. 60/974,084, filed on Sep. 21, 2007, which is hereby incorporated by reference. This application also claims the benefit of U.S. Provisional Application No. 60/977,379, filed on Oct. 4, 2007, which is hereby incorporated by reference. This application also claims the benefit of U.S. Provisional Application No. 61/044,504, filed on Apr. 13, 2008, which is hereby incorporated by reference. This application also claims the benefit of U.S. Provisional Application No. 61/076,686, filed on Jun. 29, 2008, which is hereby incorporated by reference. This application also claims the priority benefit of Korean Application No. 10-2008-0082586, filed on Aug. 22, 2008, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. The Field

The present invention relates to a digital broadcasting system and a method of processing data in a digital broadcasting system for transmitting and receiving digital broadcast signals.

2. Discussion of the Related Art

The Vestigial Sideband (VSB) transmission mode, which is adopted as the standard for digital broadcasting in North America and the Republic of Korea, is a system using a single carrier method. Therefore, the receiving performance of the receiving system may be deteriorated in a poor channel environment. Particularly, since resistance to changes in channels and noise is more highly required when using portable and/or mobile broadcast receivers, the receiving performance may be even more deteriorated when transmitting mobile service data by the VSB transmission mode.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a digital broadcasting system and a data processing method that are highly resistant to channel changes and noise.

Another object of the present invention is to provide a receiving system and a data processing method that can provide a program guide service of a mobile A/V broadcast program received through a mobile service data path by using program table information that is received through a main service data path in a dual receiving system providing both main and mobile services.

A further object of the present invention is to provide a receiving system and a data processing method that can receive data for data broadcasting through a mobile service data path, wherein the data for data broadcasting are bound with a main A/V broadcast program that is received through a main service data path in a dual receiving system providing both main and mobile services, thereby providing the received data to a user.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a receiving system includes a mobile service data processor, a main service data processor, a controller, and a display module. The mobile service data processor receives mobile service data through a mobile service data path. Herein, the mobile service data configures an RS frame, and the RS frame includes mobile service data including a mobile A/V broadcast signal and at least one channel configuration information on the mobile service data. The main service data processor receives main service data through a main service data path. Herein, the main service data includes a main A/V broadcast signal and a program guide information of the main A/V broadcast. The controller extracts a link information for the program guide service of the mobile A/V broadcast signal from the channel configuration information, and acquires a corresponding program guide information from the main service data processor by using the extracted link information. And, the display module outputs the program guide information acquired from the controller to a display screen.

Herein, the mobile A/V broadcast signal and the main A/V broadcast signal may correspond to the same broadcast signal.

The channel configuration information may correspond to table information of at least one of a service map table (SMT) and an extended service map table (EMT), and the link information may be included in at least one of the service map table (SMT) and the extended service map table (EMT) in a descriptor format and then received.

The link information may include service type information and source identification information of the mobile A/V broadcast signal.

In another aspect of the present invention, a data processing method of a receiving system includes receiving mobile service data through a mobile service data path, wherein the mobile service data configures an RS frame, and wherein the RS frame includes mobile service data including a mobile A/V broadcast signal and at least one channel configuration information on the mobile service data, receiving main service data through a main service data path, wherein the main service data includes a main A/V broadcast signal and a program guide information of the main A/V broadcast, extracting a link information for the program guide service of the mobile A/V broadcast signal from the channel configuration information, and acquiring a corresponding program guide information from the main service data processor by using the extracted link information, and outputting the program guide information acquired from the controller to a display screen.

In another aspect of the present invention, a receiving system includes a mobile service data processor, a main service data processor, a controller, and a display module. The mobile service data processor receives mobile service data through a mobile service data path. Herein, the mobile service data includes data for data broadcasting service. The main service data processor receives main service data through a main service data path. Herein, the main service data includes a main A/V broadcast signal and a table information of the main A/V broadcast. The controller extracts a link information for data broadcasting service of the main A/V broadcast signal from the table information, and acquires data for data broadcasting service bound to the main A/V broadcast signal from the mobile service data processor by using the extracted link information. And, the display module outputs the data for data broadcasting service acquired from the controller to a display screen.

Herein, the table information may correspond to a virtual channel table (VCT) information, and the link information may be included in the virtual channel table (VCT) in a descriptor format and received.

In a further aspect of the present, a data processing method of a receiving system includes receiving mobile service data through a mobile service data path, wherein the mobile service data includes data for data broadcasting service, receiving main service data through a main service data path, wherein the main service data includes a main A/V broadcast signal and a table information of the main A/V broadcast, extracting a link information for data broadcasting service of the main A/V broadcast signal from the table information, and acquiring data for data broadcasting service bound to the main A/V broadcast signal from the mobile service data processing step by using the extracted link information, and outputting the data for data broadcasting service acquired from the controller to a display screen.

Additional advantages, objects, and features of the invention may be realized and attained by the structure particularly pointed out in the written description as well as the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a block diagram showing a general structure of a digital broadcasting receiving system according to an embodiment of the present invention;

FIG. **2** illustrates an exemplary structure of a data group according to the present invention;

FIG. **3** illustrates an RS frame according to an embodiment of the present invention;

FIG. **4** illustrates an example of an MH frame structure for transmitting and receiving mobile service data according to the present invention;

FIG. **5** illustrates an example of a general VSB frame structure;

FIG. **6** illustrates a example of mapping positions of the first 4 slots of a sub-frame in a spatial area with respect to a VSB frame;

FIG. **7** illustrates a example of mapping positions of the first 4 slots of a sub-frame in a chronological (or time) area with respect to a VSB frame;

FIG. **8** illustrates an exemplary order of data groups being assigned to one of 5 sub-frames configuring an MH frame according to the present invention;

FIG. **9** illustrates an example of a single parade being assigned to an MH frame according to the present invention;

FIG. **10** illustrates an example of 3 parades being assigned to an MH frame according to the present invention;

FIG. **11** illustrates an example of the process of assigning 3 parades shown in FIG. **10** being expanded to 5 sub-frames within an MH frame;

FIG. **12** illustrates a data transmission structure according to an embodiment of the present invention, wherein signaling data are included in a data group so as to be transmitted;

FIG. **13** illustrates a hierarchical signaling structure according to an embodiment of the present invention;

FIG. **14** illustrates an exemplary FIC body format according to an embodiment of the present invention;

FIG. **15** illustrates an exemplary bit stream syntax structure with respect to an FIC segment according to an embodiment of the present invention;

FIG. **16** illustrates an exemplary bit stream syntax structure with respect to a payload of an FIC segment according to the present invention, when an FIC type field value is equal to '0';

FIG. **17** illustrates an exemplary bit stream syntax structure of a service map table according to the present invention;

FIG. **18** illustrates an exemplary bit stream syntax structure of an MH audio descriptor according to the present invention;

FIG. **19** illustrates an exemplary bit stream syntax structure of an MH RTP payload type descriptor according to the present invention;

FIG. **20** illustrates an exemplary bit stream syntax structure of an MH current event descriptor according to the present invention;

FIG. **21** illustrates an exemplary bit stream syntax structure of an MH next event descriptor according to the present invention;

FIG. **22** illustrates an exemplary bit stream syntax structure of an MH system time descriptor according to the present invention;

FIG. **23** illustrates segmentation and encapsulation processes of a service map table according to the present invention;

FIG. **24** illustrates a flow chart for accessing a virtual channel using FIC and SMT according to the present invention;

FIG. **25** illustrates an exemplary bit stream syntax structure of an EMT according to another embodiment of the present invention;

FIG. **26** illustrates a block view showing a structure of a receiving system according to a first embodiment of the present invention;

FIG. **27** illustrates an exemplary syntax structure of an event information location descriptor according to an embodiment of the present invention;

FIG. **28** illustrates a flow chart showing a method of providing a program guide service according to an embodiment of the present invention;

FIG. **29** illustrates a block view showing a structure of a receiving system according to a second embodiment of the present invention;

FIG. **30** illustrates an exemplary syntax structure of a data byte location descriptor according to an embodiment of the present invention; and

FIG. **31** illustrates a flow chart showing a method of providing a data broadcasting service according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Hereinafter, the preferred embodiment of the present invention will be described with reference to the accompanying drawings. At this time, it is to be understood that the following detailed description of the present invention illustrated in the drawings and described with reference to the drawings are exemplary and explanatory and technical spirits of the present invention and main features and operation of the present invention will not be limited by the following detailed description.

Definition of the Terms Used in the Present Invention

Although general terms, which are widely used considering functions in the present invention, have been selected in the present invention, they may be changed depending on intention of those skilled in the art, practices, or new technology. Also, in specific case, the applicant may optionally select the terms. In this case, the meaning of the terms will be described in detail in the description part of the invention. Therefore, it is to be understood that the terms should be defined based upon their meaning not their simple title and the whole description of the present invention.

Among the terms used in the description of the present invention, main service data correspond to data that can be received by a fixed receiving system and may include audio/video (A/V) data. More specifically, the main service data may include A/V data of high definition (HD) or standard definition (SD) levels and may also include diverse data types required for data broadcasting. Also, the known data correspond to data pre-known in accordance with a pre-arranged agreement between the receiving system and the transmitting system.

Additionally, among the terms used in the present invention, "MH" corresponds to the initials of "mobile" and "handheld" and represents the opposite concept of a fixed-type system. Furthermore, the MH service data may include at least one of mobile service data and handheld service data, and will also be referred to as "mobile service data" for simplicity. Herein, the mobile service data not only correspond to MH service data but may also include any type of service data with mobile or portable characteristics. Therefore, the mobile service data according to the present invention are not limited only to the MH service data.

The above-described mobile service data may correspond to data having information, such as program execution files, stock information, and so on, and may also correspond to A/V data. Most particularly, the mobile service data may correspond to A/V data having lower resolution and lower data rate as compared to the main service data. For example, if an A/V codec that is used for a conventional main service corresponds to a MPEG-2 codec, a MPEG-4 advanced video coding (AVC) or scalable video coding (SVC) having better image compression efficiency may be used as the A/V codec for the mobile service. Furthermore, any type of data may be transmitted as the mobile service data. For example, transport protocol expert group (TPEG) data for broadcasting real-time transportation information may be transmitted as the main service data.

Also, a data service using the mobile service data may include weather forecast services, traffic information services, stock information services, viewer participation quiz programs, real-time polls and surveys, interactive education broadcast programs, gaming services, services providing information on synopsis, character, background music, and filming sites of soap operas or series, services providing information on past match scores and player profiles and achievements, and services providing information on product information and programs classified by service, medium, time, and theme enabling purchase orders to be processed. Herein, the present invention is not limited only to the services mentioned above.

In the present invention, the transmitting system provides backward compatibility in the main service data so as to be received by the conventional receiving system. Herein, the main service data and the mobile service data are multiplexed to the same physical channel and then transmitted.

Furthermore, the transmitting system according to the present invention performs additional encoding on the mobile service data and inserts the data already known by the receiving system and transmitting system (e.g., known data), thereby transmitting the processed data.

Therefore, when using the transmitting system according to the present invention, the receiving system may receive the mobile service data during a mobile state and may also receive the mobile service data with stability despite various distortion and noise occurring within the channel.

Receiving System

FIG. **1** illustrates a block diagram showing a general structure of a receiving system according to an embodiment of the present invention. The receiving system according to the present invention includes a baseband processor **100**, a management processor **200**, and a presentation processor **300**.

The baseband processor **100** includes an operation controller **110**, a tuner **120**, a demodulator **130**, an equalizer **140**, a known sequence detector (or known data detector) **150**, a block decoder (or mobile handheld block decoder) **160**, a primary Reed-Solomon (RS) frame decoder **170**, a secondary RS frame decoder **180**, and a signaling decoder **190**.

The operation controller **110** controls the operation of each block included in the baseband processor **100**.

By tuning the receiving system to a specific physical channel frequency, the tuner **120** enables the receiving system to receive main service data, which correspond to broadcast signals for fixed-type broadcast receiving systems, and mobile service data, which correspond to broadcast signals for mobile broadcast receiving systems. At this point, the tuned frequency of the specific physical channel is down-converted to an intermediate frequency (IF) signal, thereby being outputted to the demodulator **130** and the known sequence detector **140**. The passband digital IF signal being outputted from the tuner **120** may only include main service data, or only include mobile service data, or include both main service data and mobile service data.

The demodulator **130** performs self-gain control, carrier recovery, and timing recovery processes on the passband digital IF signal inputted from the tuner **120**, thereby translating the IF signal to a baseband signal. Then, the demodulator **130** outputs the baseband signal to the equalizer **140** and the known sequence detector **150**. The demodulator **130** uses the known data symbol sequence inputted from the known sequence detector **150** during the timing and/or carrier recovery, thereby enhancing the demodulating performance.

The equalizer **140** compensates channel-associated distortion included in the signal demodulated by the demodulator **130**. Then, the equalizer **140** outputs the distortion-compensated signal to the block decoder **160**. By using a known data symbol sequence inputted from the known sequence detector **150**, the equalizer **140** may enhance the equalizing performance. Furthermore, the equalizer **140** may receive feedback on the decoding result from the block decoder **160**, thereby enhancing the equalizing performance.

The known sequence detector **150** detects known data place (or position) inserted by the transmitting system from the input/output data (i.e., data prior to being demodulated or data being processed with partial demodulation). Then, the known sequence detector **150** outputs the detected known data position information and known data sequence generated from the detected position information to the demodulator **130** and the equalizer **140**. Additionally, in order to allow the block decoder **160** to identify the mobile service data that have been processed with additional encoding by the transmitting system and the main service data that have not been processed with any additional encoding, the known sequence detector **150** outputs such corresponding information to the block decoder **160**.

If the data channel-equalized by the equalizer **140** and inputted to the block decoder **160** correspond to data processed with both block-encoding and trellis-encoding by the transmitting system (i.e., data within the RS frame, signaling data), the block decoder **160** may perform trellis-decoding and block-decoding as inverse processes of the transmitting system. On the other hand, if the data channel-equalized by the equalizer **140** and inputted to the block decoder **160** correspond to data processed only with trellis-encoding and not block-encoding by the transmitting system (i.e., main service data), the block decoder **160** may perform only trellis-decoding.

The signaling decoder **190** decoded signaling data that have been channel-equalized and inputted from the equalizer **140**. It is assumed that the signaling data inputted to the signaling decoder **190** correspond to data processed with both block-encoding and trellis-encoding by the transmitting system. Examples of such signaling data may include transmission parameter channel (TPC) data and fast information channel (FIC) data. Each type of data will be described in more detail in a later process. The FIC data decoded by the signaling decoder **190** are outputted to the FIC handler **215**. And, the TPC data decoded by the signaling decoder **190** are outputted to the TPC handler **214**.

Meanwhile, according to the present invention, the transmitting system uses RS frames by encoding units. Herein, the RS frame may be divided into a primary RS frame and a secondary RS frame. However, according to the embodiment of the present invention, the primary RS frame and the secondary RS frame will be divided based upon the level of importance of the corresponding data.

The primary RS frame decoder **170** receives the data outputted from the block decoder **160**. At this point, according to the embodiment of the present invention, the primary RS frame decoder **170** receives only the mobile service data that have been Reed-Solomon (RS)-encoded and/or cyclic redundancy check (CRC)-encoded from the block decoder **160**. Herein, the primary RS frame decoder **170** receives only the mobile service data and not the main service data. The primary RS frame decoder **170** performs inverse processes of an RS frame encoder (not shown) included in the transmitting system, thereby correcting errors existing within the primary RS frame. More specifically, the primary RS frame decoder **170** forms a primary RS frame by grouping a plurality of data groups and, then, correct errors in primary RS frame units. In other words, the primary RS frame decoder **170** decodes primary RS frames, which are being transmitted for actual broadcast services.

Additionally, the secondary RS frame decoder **180** receives the data outputted from the block decoder **160**. At this point, according to the embodiment of the present invention, the secondary RS frame decoder **180** receives only the mobile service data that have been RS-encoded and/or CRC-encoded from the block decoder **160**. Herein, the secondary RS frame decoder **180** receives only the mobile service data and not the main service data. The secondary RS frame decoder **180** performs inverse processes of an RS frame encoder (not shown) included in the transmitting system, thereby correcting errors existing within the secondary RS frame. More specifically, the secondary RS frame decoder **180** forms a secondary RS frame by grouping a plurality of data groups and, then, correct errors in secondary RS frame units. In other words, the secondary RS frame decoder **180** decodes secondary RS frames, which are being transmitted for mobile audio service data, mobile video service data, guide data, and so on.

Meanwhile, the management processor **200** according to an embodiment of the present invention includes an MH physical adaptation processor **210**, an IP network stack **220**, a streaming handler **230**, a system information (SI) handler **240**, a file handler **250**, a multi-purpose internet main extensions (MIME) type handler **260**, and an electronic service guide (ESG) handler **270**, and an ESG decoder **280**, and a storage unit **290**.

The MH physical adaptation processor **210** includes a primary RS frame handler **211**, a secondary RS frame handler **212**, an MH transport packet (TP) handler **213**, a TPC handler **214**, an FIC handler **215**, and a physical adaptation control signal handler **216**.

The TPC handler **214** receives and processes baseband information required by modules corresponding to the MH physical adaptation processor **210**. The baseband information is inputted in the form of TPC data. Herein, the TPC handler **214** uses this information to process the FIC data, which have been sent from the baseband processor **100**.

The TPC data are transmitted from the transmitting system to the receiving system via a predetermined region of a data group. The TPC data may include at least one of an MH ensemble ID, an MH sub-frame number, a total number of MH groups (TNoG), an RS frame continuity counter, a column size of RS frame (N), and an FIC version number.

Herein, the MH ensemble ID indicates an identification number of each MH ensemble carried in the corresponding channel.

The MH sub-frame number signifies a number identifying the MH sub-frame number in an MH frame, wherein each MH group associated with the corresponding MH ensemble is transmitted.

The TNoG represents the total number of MH groups including all of the MH groups belonging to all MH parades included in an MH sub-frame.

The RS frame continuity counter indicates a number that serves as a continuity counter of the RS frames carrying the corresponding MH ensemble. Herein, the value of the RS frame continuity counter shall be incremented by 1 modulo 16 for each successive RS frame.

N represents the column size of an RS frame belonging to the corresponding MH ensemble. Herein, the value of N determines the size of each MH TP.

Finally, the FIC version number signifies the version number of an FIC carried on the corresponding physical channel.

As described above, diverse TPC data are inputted to the TPC handler **214** via the signaling decoder **190** shown in FIG. **1**. Then, the received TPC data are processed by the TPC handler **214**. The received TPC data may also be used by the FIC handler **215** in order to process the FIC data.

The FIC handler **215** processes the FIC data by associating the FIC data received from the baseband processor **100** with the TPC data.

The physical adaptation control signal handler **216** collects FIC data received through the FIC handler **215** and SI data received through RS frames. Then, the physical adaptation control signal handler **216** uses the collected FIC data and SI data to configure and process IP datagrams and access information of mobile broadcast services. Thereafter, the physical adaptation control signal handler **216** stores the processed IP datagrams and access information to the storage unit **290**.

The primary RS frame handler **211** identifies primary RS frames received from the primary RS frame decoder **170** of the baseband processor **100** for each row unit, so as to configure an MH TP. Thereafter, the primary RS frame handler **211** outputs the configured MH TP to the MH TP handler **213**.

The secondary RS frame handler **212** identifies secondary RS frames received from the secondary RS frame decoder **180** of the baseband processor **100** for each row unit, so as to configure an MH TP. Thereafter, the secondary RS frame handler **212** outputs the configured MH TP to the MH TP handler **213**.

The MH transport packet (TP) handler **213** extracts a header from each MH TP received from the primary RS frame handler **211** and the secondary RS frame handler **212**, thereby determining the data included in the corresponding MH TP. Then, when the determined data correspond to SI data (i.e., SI data that are not encapsulated to IP datagrams), the corresponding data are outputted to the physical adaptation control signal handler **216**. Alternatively, when the determined data correspond to an IP datagram, the corresponding data are outputted to the IP network stack **220**.

The IP network stack **220** processes broadcast data that are being transmitted in the form of IP datagrams. More specifically, the IP network stack **220** processes data that are inputted via user datagram protocol (UDP), real-time transport protocol (RTP), real-time transport control protocol (RTCP), asynchronous layered coding/layered coding transport (ALC/LCT), file delivery over unidirectional transport (FLUTE), and so on. Herein, when the processed data correspond to streaming data, the corresponding data are outputted to the streaming handler **230**. And, when the processed data correspond to data in a file format, the corresponding data are outputted to the file handler **250**. Finally, when the processed data correspond to SI-associated data, the corresponding data are outputted to the SI handler **240**.

The SI handler **240** receives and processes SI data having the form of IP datagrams, which are inputted to the IP network stack **220**.

When the inputted data associated with SI correspond to MIME-type data, the inputted data are outputted to the MIME-type handler **260**.

The MIME-type handler **260** receives the MIME-type SI data outputted from the SI handler **240** and processes the received MIME-type SI data.

The file handler **250** receives data from the IP network stack **220** in an object format in accordance with the ALC/LCT and FLUTE structures. The file handler **250** groups the received data to create a file format. Herein, when the corresponding file includes ESG, the file is outputted to the ESG handler **270**. On the other hand, when the corresponding file includes data for other file-based services, the file is outputted to the presentation controller **330** of the presentation processor **300**.

The ESG handler **270** processes the ESG data received from the file handler **250** and stores the processed ESG data to the storage unit **290**. Alternatively, the ESG handler **270** may output the processed ESG data to the ESG decoder **280**, thereby allowing the ESG data to be used by the ESG decoder **280**.

The storage unit **290** stores the system information (SI) received from the physical adaptation control signal handler **210** and the ESG handler **270** therein. Thereafter, the storage unit **290** transmits the stored SI data to each block.

The ESG decoder **280** either recovers the ESG data and SI data stored in the storage unit **290** or recovers the ESG data transmitted from the ESG handler **270**. Then, the ESG decoder **280** outputs the recovered data to the presentation controller **330** in a format that can be outputted to the user.

The streaming handler **230** receives data from the IP network stack **220**, wherein the format of the received data are in accordance with RTP and/or RTCP structures. The streaming handler **230** extracts audio/video streams from the received data, which are then outputted to the audio/video (A/V) decoder **310** of the presentation processor **300**. The audio/video decoder **310** then decodes each of the audio stream and video stream received from the streaming handler **230**.

The display module **320** of the presentation processor **300** receives audio and video signals respectively decoded by the A/V decoder **310**. Then, the display module **320** provides the received audio and video signals to the user through a speaker and/or a screen.

The presentation controller **330** corresponds to a controller managing modules that output data received by the receiving system to the user.

The channel service manager **340** manages an interface with the user, which enables the user to use channel-based broadcast services, such as channel map management, channel service connection, and so on.

The application manager **350** manages an interface with a user using ESG display or other application services that do not correspond to channel-based services.

Data Format Structure

Meanwhile, the data structure used in the mobile broadcasting technology according to the embodiment of the present invention may include a data group structure and an RS frame structure, which will now be described in detail.

FIG. **2** illustrates an exemplary structure of a data group according to the present invention.

FIG. **2** shows an example of dividing a data group according to the data structure of the present invention into 10 MH blocks (i.e., MH block **1** (B**1**) to MH block **10** (B**10**)). In this example, each MH block has the length of 16 segments. Referring to FIG. **2**, only the RS parity data are allocated to portions of the previous 5 segments of the MH block **1** (B**1**) and the next 5 segments of the MH block **10** (B**10**). The RS parity data are excluded in regions A to D of the data group.

More specifically, when it is assumed that one data group is divided into regions A, B, C, and D, each MH block may be included in any one of region A to region D depending upon the characteristic of each MH block within the data group. Herein, the data group is divided into a plurality of regions to be used for different purposes. More specifically, a region of the main service data having no interference or a very low interference level may be considered to have a more resistant (or stronger) receiving performance as compared to regions having higher interference levels. Additionally, when using a system inserting and transmitting known data in the data group, wherein the known data are known based upon an agreement between the transmitting system and the receiving system, and when consecutively long known data are to be periodically inserted in the mobile service data, the known data having a predetermined length may be periodically inserted in the region having no interference from the main service data (i.e., a region wherein the main service data are not mixed). However, due to interference from the main service data, it is difficult to periodically insert known data and also to insert consecutively long known data to a region having interference from the main service data.

Referring to FIG. **2**, MH block **4** (B**4**) to MH block **7** (B**7**) correspond to regions without interference of the main service data. MH block **4** (B**4**) to MH block **7** (B**7**) within the data group shown in FIG. **2** correspond to a region where no interference from the main service data occurs. In this example, a long known data sequence is inserted at both the beginning and end of each MH block. In the description of the present invention, the region including MH block **4** (B**4**) to MH block **7** (B**7**) will be referred to as "region A (=B**4**+B**5**+B**6**+B**7**)". As described above, when the data group includes region A having a long known data sequence inserted at both the beginning and end of each MH block, the receiving system is capable of performing equalization by using the channel information that can be obtained from the known data. Therefore, the strongest equalizing performance may be yielded (or obtained) from one of region A to region D.

In the example of the data group shown in FIG. **2**, MH block **3** (B**3**) and MH block **8** (B**8**) correspond to a region having little interference from the main service data. Herein, a long known data sequence is inserted in only one side of each MH block B**3** and B**8**. More specifically, due to the interference from the main service data, a long known data sequence is inserted at the end of MH block **3** (B**3**), and another long known data sequence is inserted at the beginning of MH block **8** (B**8**). In the present invention, the region including MH block **3** (B**3**) and MH block **8** (B**8**) will be referred to as "region B (=B**3**+B**8**)". As described above, when the data group includes region B having a long known data sequence inserted at only one side (beginning or end) of each MH block, the receiving system is capable of performing equalization by using the channel information that can be obtained from the known data. Therefore, a stronger equalizing performance as compared to region C/D may be yielded (or obtained).

Referring to FIG. **2**, MH block **2** (B**2**) and MH block **9** (B**9**) correspond to a region having more interference from the main service data as compared to region B. A long known data sequence cannot be inserted in any side of MH block **2** (B**2**) and MH block **9** (B**9**). Herein, the region including MH block **2** (B**2**) and MH block **9** (B**9**) will be referred to as "region C (=B**2**+B**9**)".

Finally, in the example shown in FIG. **2**, MH block **1** (B**1**) and MH block **10** (B**10**) correspond to a region having more interference from the main service data as compared to region C. Similarly, a long known data sequence cannot be inserted in any side of MH block **1** (B**1**) and MH block **10** (B**10**). Herein, the region including MH block **1** (B**1**) and MH block **10** (B**10**) will be referred to as "region D (=B**1**+B**10**)". Since region C/D is spaced further apart from the known data sequence, when the channel environment undergoes frequent and abrupt changes, the receiving performance of region C/D may be deteriorated.

Additionally, the data group includes a signaling information area wherein signaling information is assigned (or allocated).

In the present invention, the signaling information area may start from the 1^{st} segment of the 4^{th} MH block (B**4**) to a portion of the 2^{nd} segment. According to an embodiment of the present invention, the signaling information area for inserting signaling information may start from the 1^{st} segment of the 4^{th} MH block (B**4**) to a portion of the 2^{nd} segment.

More specifically, 276 (=207+69) bytes of the 4^{th} MH block (B**4**) in each data group are assigned as the signaling information area. In other words, the signaling information area consists of 207 bytes of the 1^{st} segment and the first 69 bytes of the 2^{nd} segment of the 4^{th} MH block (B**4**). The 1^{st} segment of the 4^{th} MH block (B**4**) corresponds to the 17^{th} or 173^{rd} segment of a VSB field.

Herein, the signaling information may be identified by two different types of signaling channels: a transmission parameter channel (TPC) and a fast information channel (FIC).

Herein, the TPC data may include at least one of an MH ensemble ID, an MH sub-frame number, a total number of MH groups (TNoG), an RS frame continuity counter, a column size of RS frame (N), and an FIC version number. However, the TPC data (or information) presented herein are merely exemplary. And, since the adding or deleting of signaling information included in the TPC data may be easily adjusted and modified by one skilled in the art, the present invention will, therefore, not be limited to the examples set forth herein. Furthermore, the FIC is provided to enable a fast service acquisition of data receivers, and the FIC includes cross layer information between the physical layer and the upper layer(s).

For example, when the data group includes 6 known data sequences, as shown in FIG. **2**, the signaling information area is located between the first known data sequence and the second known data sequence. More specifically, the first known data sequence is inserted in the last 2 segments of the 3^{rd} MH block (B**3**), and the second known data sequence in inserted in the 2^{nd} and 3^{rd} segments of the 4^{th} MH block (B**4**). Furthermore, the 3^{rd} to 6^{th} known data sequences are respectively inserted in the last 2 segments of each of the 4^{th}, 5^{th}, 6^{th}, and 7^{th} MH blocks (B**4**, B**5**, B**6**, and B**7**). The 1^{st} and 3^{rd} to 6^{th} known data sequences are spaced apart by 16 segments.

FIG. **3** illustrates an RS frame according to an embodiment of the present invention.

The RS frame shown in FIG. **3** corresponds to a collection of one or more data groups. The RS frame is received for each MH frame in a condition where the receiving system receives the FIC and processes the received FIC and where the receiving system is switched to a time-slicing mode so that the receiving system can receive MH ensembles including ESG entry points. Each RS frame includes IP streams of each service or ESG, and SMT section data may exist in all RS frames.

The RS frame according to the embodiment of the present invention consists of at least one MH transport packet (TP) Herein, the MH TP includes an MH header and an MH payload.

The MH payload may include mobile service data as well as signaling data. More specifically, an MH payload may include only mobile service data, or may include only signaling data, or may include both mobile service data and signaling data.

According to the embodiment of the present invention, the MH header may identify (or distinguish) the data types included in the MH payload. More specifically, when the MH TP includes a first MH header, this indicates that the MH payload includes only the signaling data. Also, when the MH TP includes a second MH header, this indicates that the MH payload includes both the signaling data and the mobile service data. Finally, when MH TP includes a third MH header, this indicates that the MH payload includes only the mobile service data.

In the example shown in FIG. **3**, the RS frame is assigned with IP datagrams (IP datagram **1** and IP datagram **2**) for two service types.

Data Transmission Structure

FIG. **4** illustrates a structure of a MH frame for transmitting and receiving mobile service data according to the present invention. In the example shown in FIG. **4**, one MH frame consists of 5 sub-frames, wherein each sub-frame includes 16 slots. In this case, the MH frame according to the present invention includes 5 sub-frames and 80 slots. Also, in a packet level, one slot is configured of 156 data packets (i.e., transport stream packets), and in a symbol level, one slot is configured of 156 data segments. Herein, the size of one slot corresponds to one half (½) of a VSB field. More specifically, since one 207-byte data packet has the same amount of data as a data segment, a data packet prior to being interleaved may also be used as a data segment. At this point, two VSB fields are grouped to form a VSB frame.

FIG. **5** illustrates an exemplary structure of a VSB frame, wherein one VSB frame consists of 2 VSB fields (i.e., an odd field and an even field). Herein, each VSB field includes a field synchronization segment and 312 data segments.

The slot corresponds to a basic time unit for multiplexing the mobile service data and the main service data. Herein, one slot may either include the mobile service data or be configured only of the main service data.

If the first 118 data packets within the slot correspond to a data group, the remaining 38 data packets become the main service data packets. In another example, when no data group exists in a slot, the corresponding slot is configured of 156 main service data packets.

Meanwhile, when the slots are assigned to a VSB frame, an off-set exists for each assigned position.

FIG. **6** illustrates a mapping example of the positions to which the first 4 slots of a sub-frame are assigned with respect to a VSB frame in a spatial area. And, FIG. 7 illustrates a mapping example of the positions to which the first 4 slots of a sub-frame are assigned with respect to a VSB frame in a chronological (or time) area.

Referring to FIG. 6 and FIG. 7, a 38^{th} data packet (TS packet #37) of a 1^{st} slot (Slot #0) is mapped to the 1^{st} data packet of an odd VSB field. A 38^{th} data packet (TS packet #37) of a 2^{nd} slot (Slot #1) is mapped to the 157^{th} data packet of an odd VSB field. Also, a 38^{th} data packet (TS packet #37) of a 3^{rd} slot (Slot #2) is mapped to the 1^{st} data packet of an even VSB field. And, a 38^{th} data packet (TS packet #37) of a 4^{th} slot (Slot #3) is mapped to the 157^{th} data packet of an even VSB field. Similarly, the remaining 12 slots within the corresponding sub-frame are mapped in the subsequent VSB frames using the same method.

FIG. 8 illustrates an exemplary assignment order of data groups being assigned to one of 5 sub-frames, wherein the 5 sub-frames configure an MH frame. For example, the method of assigning data groups may be identically applied to all MH frames or differently applied to each MH frame. Furthermore, the method of assigning data groups may be identically applied to all sub-frames or differently applied to each sub-frame. At this point, when it is assumed that the data groups are assigned using the same method in all sub-frames of the corresponding MH frame, the total number of data groups being assigned to an MH frame is equal to a multiple of '5'.

According to the embodiment of the present invention, a plurality of consecutive data groups is assigned to be spaced as far apart from one another as possible within the sub-frame. Thus, the system can be capable of responding promptly and effectively to any burst error that may occur within a sub-frame.

For example, when it is assumed that 3 data groups are assigned to a sub-frame, the data groups are assigned to a 1^{st} slot (Slot #0), a 5^{th} slot (Slot #4), and a 9^{th} slot (Slot #8) in the sub-frame, respectively. FIG. 8 illustrates an example of assigning 16 data groups in one sub-frame using the above-described pattern (or rule). In other words, each data group is serially assigned to 16 slots corresponding to the following numbers: 0, 8, 4, 12, 1, 9, 5, 13, 2, 10, 6, 14, 3, 11, 7, and 15. Equation 1 below shows the above-described rule (or pattern) for assigning data groups in a sub-frame.

$$j=(4i+0)\bmod 16 \qquad \text{Equation 1}$$

0=0 if i<4,
0=2 else if i<8,
Herein,
0=1 else if i<12,
0=3 else.

Herein, j indicates the slot number within a sub-frame. The value of j may range from 0 to 15 (i.e., $0 \leqq j \leqq 15$). Also, variable i indicates the data group number. The value of i may range from 0 to 15 (i.e., $0 \leqq i \leqq 15$).

In the present invention, a collection of data groups included in a MH frame will be referred to as a "parade". Based upon the RS frame mode, the parade transmits data of at least one specific RS frame.

The mobile service data within one RS frame may be assigned either to all of regions A/B/C/D within the corresponding data group, or to at least one of regions A/B/C/D. In the embodiment of the present invention, the mobile service data within one RS frame may be assigned either to all of regions A/B/C/D, or to at least one of regions A/B and regions C/D. If the mobile service data are assigned to the latter case (i.e., one of regions A/B and regions C/D), the RS frame being assigned to regions A/B and the RS frame being assigned to regions C/D within the corresponding data group are different from one another. According to the embodiment of the present invention, the RS frame being assigned to regions A/B within the corresponding data group will be referred to as a "primary RS frame", and the RS frame being assigned to regions C/D within the corresponding data group will be referred to as a "secondary RS frame", for simplicity. Also, the primary RS frame and the secondary RS frame form (or configure) one parade. More specifically, when the mobile service data within one RS frame are assigned either to all of regions A/B/C/D within the corresponding data group, one parade transmits one RS frame. Conversely, when the mobile service data within one RS frame are assigned either to at least one of regions A/B and regions C/D, one parade may transmit up to 2 RS frames.

More specifically, the RS frame mode indicates whether a parade transmits one RS frame, or whether the parade transmits two RS frames. Such RS frame mode is transmitted as the above-described TPC data.

Table 1 below shows an example of the RS frame mode.

TABLE 1

RS frame mode (2 bits)	Description
00	There is only one primary RS frame for all group regions
01	There are two separate RS frames. Primary RS frame for group regions A and B Secondary RS frame for group regions C and D
10	Reserved
11	Reserved

Table 1 illustrates an example of allocating 2 bits in order to indicate the RS frame mode. For example, referring to Table 1, when the RS frame mode value is equal to '00', this indicates that one parade transmits one RS frame. And, when the RS frame mode value is equal to '01', this indicates that one parade transmits two RS frames, i.e., the primary RS frame and the secondary RS frame. More specifically, when the RS frame mode value is equal to '01', data of the primary RS frame for regions A/B are assigned and transmitted to regions A/B of the corresponding data group. Similarly, data of the secondary RS frame for regions C/D are assigned and transmitted to regions C/D of the corresponding data group.

As described in the assignment of data groups, the parades are also assigned to be spaced as far apart from one another as possible within the sub-frame. Thus, the system can be capable of responding promptly and effectively to any burst error that may occur within a sub-frame.

Furthermore, the method of assigning parades may be identically applied to all MH frames or differently applied to each MH frame. According to the embodiment of the present invention, the parades may be assigned differently for each MH frame and identically for all sub-frames within an MH frame. More specifically, the MH frame structure may vary by MH frame units. Thus, an ensemble rate may be adjusted on a more frequent and flexible basis.

FIG. 9 illustrates an example of multiple data groups of a single parade being assigned (or allocated) to an MH frame. More specifically, FIG. 9 illustrates an example of a plurality of data groups included in a single parade, wherein the number of data groups included in a sub-frame is equal to '3', being allocated to an MH frame.

Referring to FIG. 9, 3 data groups are sequentially assigned to a sub-frame at a cycle period of 4 slots. Accordingly, when this process is equally performed in the 5 sub-frames included in the corresponding MH frame, 15 data groups are assigned to a single MH frame. Herein, the 15 data groups correspond to data groups included in a parade. Therefore, since one sub-frame is configured of 4 VSB frame, and since 3 data groups are included in a sub-frame, the data group of the corresponding parade is not assigned to one of the 4 VSB frames within a sub-frame.

For example, when it is assumed that one parade transmits one RS frame, and that a RS frame encoder (not shown) included in the transmitting system performs RS-encoding on the corresponding RS frame, thereby adding 24 bytes of parity data to the corresponding RS frame and transmitting the processed RS frame, the parity data occupy approximately 11.37% (=24/(187+24)×100) of the total code word length. Meanwhile, when one sub-frame includes 3 data groups, and when the data groups included in the parade are assigned, as shown in FIG. **9**, a total of 15 data groups form an RS frame. Accordingly, even when an error occurs in an entire data group due to a burst noise within a channel, the percentile is merely 6.67% (=1/15×100). Therefore, the receiving system may correct all errors by performing an erasure RS decoding process. More specifically, when the erasure RS decoding is performed, a number of channel errors corresponding to the number of RS parity bytes may be corrected. By doing so, the receiving system may correct the error of at least one data group within one parade. Thus, the minimum burst noise length correctable by a RS frame is over 1 VSB frame.

Meanwhile, when data groups of a parade are assigned as shown in FIG. **9**, either main service data may be assigned between each data group, or data groups corresponding to different parades may be assigned between each data group. More specifically, data groups corresponding to multiple parades may be assigned to one MH frame.

Basically, the method of assigning data groups corresponding to multiple parades is very similar to the method of assigning data groups corresponding to a single parade. In other words, data groups included in other parades that are to be assigned to an MH frame are also respectively assigned according to a cycle period of 4 slots.

At this point, data groups of a different parade may be sequentially assigned to the respective slots in a circular method. Herein, the data groups are assigned to slots starting from the ones to which data groups of the previous parade have not yet been assigned.

For example, when it is assumed that data groups corresponding to a parade are assigned as shown in FIG. **9**, data groups corresponding to the next parade may be assigned to a sub-frame starting either from the 12^{th} slot of a sub-frame. However, this is merely exemplary. In another example, the data groups of the next parade may also be sequentially assigned to a different slot within a sub-frame at a cycle period of 4 slots starting from the 3^{rd} slot.

FIG. **10** illustrates an example of transmitting 3 parades (Parade #**0**, Parade #**1**, and Parade #**2**) to an MH frame. More specifically, FIG. **10** illustrates an example of transmitting parades included in one of 5 sub-frames, wherein the 5 sub-frames configure one MH frame.

When the 1^{st} parade (Parade #**0**) includes 3 data groups for each sub-frame, the positions of each data groups within the sub-frames may be obtained by substituting values '0' to '2' for i in Equation 1. More specifically, the data groups of the 1^{st} parade (Parade #**0**) are sequentially assigned to the 1^{st}, 5^{th}, and 9^{th} slots (Slot #**0**, Slot #**4**, and Slot #**8**) within the sub-frame.

Also, when the 2^{nd} parade includes 2 data groups for each sub-frame, the positions of each data groups within the sub-frames may be obtained by substituting values '3' and '4' for i in Equation 1. More specifically, the data groups of the 2^{nd} parade (Parade #**1**) are sequentially assigned to the 2^{nd} and 12^{th} slots (Slot #**1** and Slot #**11**) within the sub-frame.

Finally, when the 3^{rd} parade includes 2 data groups for each sub-frame, the positions of each data groups within the sub-frames may be obtained by substituting values '5' and '6' for i in Equation 1. More specifically, the data groups of the 3^{rd} parade (Parade #**2**) are sequentially assigned to the 7^{th} and 11^{th} slots (Slot #**6** and Slot #**10**) within the sub-frame.

As described above, data groups of multiple parades may be assigned to a single MH frame, and, in each sub-frame, the data groups are serially allocated to a group space having 4 slots from left to right.

Therefore, a number of groups of one parade per sub-frame (NoG) may correspond to any one integer from '1' to '8'. Herein, since one MH frame includes 5 sub-frames, the total number of data groups within a parade that can be allocated to an MH frame may correspond to any one multiple of '5' ranging from '5' to '40'.

FIG. **11** illustrates an example of expanding the assignment process of 3 parades, shown in FIG. **10**, to 5 sub-frames within an MH frame.

FIG. **12** illustrates a data transmission structure according to an embodiment of the present invention, wherein signaling data are included in a data group so as to be transmitted.

As described above, an MH frame is divided into 5 sub-frames. Data groups corresponding to a plurality of parades co-exist in each sub-frame. Herein, the data groups corresponding to each parade are grouped by MH frame units, thereby configuring a single parade.

The data structure shown in FIG. **12** includes 3 parades, one ESG dedicated channel (EDC) parade (i.e., parade with NoG=1), and 2 service parades (i.e., parade with NoG=4 and parade with NoG=3). Also, a predetermined portion of each data group (i.e., 37 bytes/data group) is used for delivering (or sending) FIC information associated with mobile service data, wherein the FIC information is separately encoded from the RS-encoding process. The FIC region assigned to each data group consists of one FIC segments. Herein, each segment is interleaved by MH sub-frame units, thereby configuring an FIC body, which corresponds to a completed FIC transmission structure. However, whenever required, each segment may be interleaved by MH frame units and not by MH sub-frame units, thereby being completed in MH frame units.

Meanwhile, the concept of an MH ensemble is applied in the embodiment of the present invention, thereby defining a collection (or group) of services. Each MH ensemble carries the same QoS and is coded with the same FEC code. Also, each MH ensemble has the same unique identifier (i.e., ensemble ID) and corresponds to consecutive RS frames.

As shown in FIG. **12**, the FIC segment corresponding to each data group described service information of an MH ensemble to which the corresponding data group belongs. When FIC segments within a sub-frame are grouped and deinterleaved, all service information of a physical channel through which the corresponding FICs are transmitted may be obtained. Therefore, the receiving system may be able to acquire the channel information of the corresponding physical channel, after being processed with physical channel tuning, during a sub-frame period.

Furthermore, FIG. **12** illustrates a structure further including a separate EDC parade apart from the service parade and wherein electronic service guide (ESG) data are transmitted in the 1^{st} slot of each sub-frame.

Hierarchical Signaling Structure

FIG. **13** illustrates a hierarchical signaling structure according to an embodiment of the present invention. As shown in FIG. **13**, the mobile broadcasting technology according to the embodiment of the present invention adopts a signaling method using FIC and SMT. In the description of the present invention, the signaling structure will be referred to as a hierarchical signaling structure.

Hereinafter, a detailed description on how the receiving system accesses a virtual channel via FIC and SMT will now be given with reference to FIG. **13**.

The FIC body defined in an MH transport (M**1**) identifies the physical location of each the data stream for each virtual channel and provides very high level descriptions of each virtual channel.

Being MH ensemble level signaling information, the service map table (SMT) provides MH ensemble level signaling information. The SMT provides the IP access information of each virtual channel belonging to the respective MH ensemble within which the SMT is carried. The SMT also provides all IP stream component level information required for the virtual channel service acquisition.

Referring to FIG. **13**, each MH ensemble (i.e., Ensemble **0**, Ensemble **1**, . . . , Ensemble K) includes a stream information on each associated (or corresponding) virtual channel (e.g., virtual channel 0 IP stream, virtual channel 1 IP stream, and virtual channel 2 IP stream). For example, Ensemble **0** includes virtual channel 0 IP stream and virtual channel 1 IP stream. And, each MH ensemble includes diverse information on the associated virtual channel (i.e., Virtual Channel 0 Table Entry, Virtual Channel 0 Access Info, Virtual Channel 1 Table Entry, Virtual Channel 1 Access Info, Virtual Channel 2 Table Entry, Virtual Channel 2 Access Info, Virtual Channel N Table Entry, Virtual Channel N Access Info, and so on).

The FIC body payload includes information on MH ensembles (e.g., ensemble_id field, and referred to as "ensemble location" in FIG. **13**) and information on a virtual channel associated with the corresponding MH ensemble (e.g., when such information corresponds to a major_channel_num field and a minor_channel_num field, the information is expressed as Virtual Channel 0, Virtual Channel 1, . . . , Virtual Channel N in FIG. **13**).

The application of the signaling structure in the receiving system will now be described in detail.

When a user selects a channel he or she wishes to view (hereinafter, the user-selected channel will be referred to as "channel θ" for simplicity), the receiving system first parses the received FIC. Then, the receiving system acquires information on an MH ensemble (i.e., ensemble location), which is associated with the virtual channel corresponding to channel θ (hereinafter, the corresponding MH ensemble will be referred to as "MH ensemble θ" for simplicity). By acquiring slots only corresponding to the MH ensemble θ using the time-slicing method, the receiving system configures ensemble θ. The ensemble θ configured as described above, includes an SMT on the associated virtual channels (including channel θ) and IP streams on the corresponding virtual channels. Therefore, the receiving system uses the SMT included in the MH ensemble θ in order to acquire various information on channel θ (e.g., Virtual Channel θ Table Entry) and stream access information on channel θ (e.g., Virtual Channel θ Access Info). The receiving system uses the stream access information on channel θ to receive only the associated IP streams, thereby providing channel θ services to the user.

Fast Information Channel (FIC)

The receiving system according to the present invention adopts the fast information channel (FIC) for a faster access to a service that is currently being broadcasted.

More specifically, the FIC handler **215** of FIG. **1** parses the FIC body, which corresponds to an FIC transmission structure, and outputs the parsed result to the physical adaptation control signal handler **216**.

FIG. **14** illustrates an exemplary FIC body format according to an embodiment of the present invention. According to the embodiment of the present invention, the FIC format consists of an FIC body header and an FIC body payload.

Meanwhile, according to the embodiment of the present invention, data are transmitted through the FIC body header and the FIC body payload in FIC segment units. Each FIC segment has the size of 37 bytes, and each FIC segment consists of a 2-byte FIC segment header and a 35-byte FIC segment payload. More specifically, an FIC body configured of an FIC body header and an FIC body payload, is segmented in units of 35 data bytes, which are then carried in at least one FIC segment within the FIC segment payload, so as to be transmitted.

In the description of the present invention, an example of inserting one FIC segment in one data group, which is then transmitted, will be given. In this case, the receiving system receives a slot corresponding to each data group by using a time-slicing method.

The signaling decoder **190** included in the receiving system shown in FIG. **1** collects each FIC segment inserted in each data group. Then, the signaling decoder **190** uses the collected FIC segments to created a single FIC body. Thereafter, the signaling decoder **190** performs a decoding process on the FIC body payload of the created FIC body, so that the decoded FIC body payload corresponds to an encoded result of a signaling encoder (not shown) included in the transmitting system. Subsequently, the decoded FIC body payload is outputted to the FIC handler **215**. The FIC handler **215** parses the FIC data included in the FIC body payload, and then outputs the parsed FIC data to the physical adaptation control signal handler **216**. The physical adaptation control signal handler **216** uses the inputted FIC data to perform processes associated with MH ensembles, virtual channels, SMTs, and so on.

According to an embodiment of the present invention, when an FIC body is segmented, and when the size of the last segmented portion is smaller than 35 data bytes, it is assumed that the lacking number of data bytes in the FIC segment payload is completed with by adding the same number of stuffing bytes therein, so that the size of the last FIC segment can be equal to 35 data bytes.

However, it is apparent that the above-described data byte values (i.e., 37 bytes for the FIC segment, 2 bytes for the FIC segment header, and 35 bytes for the FIC segment payload) are merely exemplary, and will, therefore, not limit the scope of the present invention.

FIG. **15** illustrates an exemplary bit stream syntax structure with respect to an FIC segment according to an embodiment of the present invention.

Herein, the FIC segment signifies a unit used for transmitting the FIC data. The FIC segment consists of an FIC segment header and an FIC segment payload. Referring to FIG. **15**, the FIC segment payload corresponds to the portion starting from the 'for' loop statement. Meanwhile, the FIC segment header may include a FIC_type field, an error_indicator field, an FIC_seg_number field, and an FIC_last_seg_number field. A detailed description of each field will now be given.

The FIC_type field is a 2-bit field indicating the type of the corresponding FIC.

The error_indicator field is a 1-bit field, which indicates whether or not an error has occurred within the FIC segment during data transmission. If an error has occurred, the value of the error_indicator field is set to '1'. More specifically, when an error that has failed to be recovered still remains during the configuration process of the FIC segment, the error_indicator field value is set to '1'. The error_indicator field enables the receiving system to recognize the presence of an error within the FIC data.

The FIC_seg_number field is a 4-bit field. Herein, when a single FIC body is divided into a plurality of FIC segments and transmitted, the FIC_seg_number field indicates the number of the corresponding FIC segment.

Finally, the FIC_last_seg_number field is also a 4-bit field. The FIC_last_seg_number field indicates the number of the last FIC segment within the corresponding FIC body.

FIG. **16** illustrates an exemplary bit stream syntax structure with respect to a payload of an FIC segment according to the present invention, when an FIC type field value is equal to '0'.

According to the embodiment of the present invention, the payload of the FIC segment is divided into 3 different regions.

A first region of the FIC segment payload exists only when the FIC_seg_number field value is equal to '0'. Herein, the first region may include a current_next_indicator field, an ESG_version field, and a transport_stream_id field. However, depending upon the embodiment of the present invention, it may be assumed that each of the 3 fields exists regardless of the FIC_seg_number field.

The current_next_indicator field is a 1-bit field. The current_next_indicator field acts as an indicator identifying whether the corresponding FIC data carry MH ensemble configuration information of an MH frame including the current FIC segment, or whether the corresponding FIC data carry MH ensemble configuration information of a next MH frame.

The ESG_version field is a 5-bit field indicating ESG version information. Herein, by providing version information on the service guide providing channel of the corresponding ESG, the ESG_version field enables the receiving system to notify whether or not the corresponding ESG has been updated.

Finally, the transport_stream_id field is a 16-bit field acting as a unique identifier of a broadcast stream through which the corresponding FIC segment is being transmitted.

A second region of the FIC segment payload corresponds to an ensemble loop region, which includes an ensemble_id field, an SI_version field, and a num_channel field.

More specifically, the ensemble_id field is an 8-bit field indicating identifiers of an MH ensemble through which MH services are transmitted. The MH services will be described in more detail in a later process. Herein, the ensemble_id field binds the MH services and the MH ensemble.

The SI_version field is a 4-bit field indicating version information of SI data included in the corresponding ensemble, which is being transmitted within the RS frame.

Finally, the num_channel field is an 8-bit field indicating the number of virtual channel being transmitted via the corresponding ensemble.

A third region of the FIC segment payload a channel loop region, which includes a channel_type field, a channel_activity field, a CA_indicator field, a stand_alone_service_indicator field, a major_channel_num field, and a minor_channel_num field.

The channel_type field is a 5-bit field indicating a service type of the corresponding virtual channel. For example, the channel_type field may indicates an audio/video channel, an audio/video and data channel, an audio-only channel, a data-only channel, a file download channel, an ESG delivery channel, a notification channel, and so on.

The channel_activity field is a 2-bit field indicating activity information of the corresponding virtual channel. More specifically, the channel_activity field may indicate whether the current virtual channel is providing the current service.

The CA_indicator field is a 1-bit field indicating whether or not a conditional access (CA) is applied to the current virtual channel.

The stand_alone_service_indicator field is also a 1-bit field, which indicates whether the service of the corresponding virtual channel corresponds to a stand alone service.

The major_channel_num field is an 8-bit field indicating a major channel number of the corresponding virtual channel.

Finally, the minor_channel_num field is also an 8-bit field indicating a minor channel number of the corresponding virtual channel.

Service Table Map

FIG. **17** illustrates an exemplary bit stream syntax structure of a service map table (hereinafter referred to as "SMT") according to the present invention.

According to the embodiment of the present invention, the SMT is configured in an MPEG-2 private section format. However, this will not limit the scope and spirit of the present invention. The SMT according to the embodiment of the present invention includes description information for each virtual channel within a single MH ensemble. And, additional information may further be included in each descriptor area.

Herein, the SMT according to the embodiment of the present invention includes at least one field and is transmitted from the transmitting system to the receiving system.

As described in FIG. **3**, the SMT section may be transmitted by being included in the MH TP within the RS frame. In this case, each of the RS frame decoders **170** and **180**, shown in FIG. **1**, decodes the inputted RS frame, respectively. Then, each of the decoded RS frames is outputted to the respective RS frame handler **211** and **212**. Thereafter, each RS frame handler **211** and **212** identifies the inputted RS frame by row units, so as to create an MH TP, thereby outputting the created MH TP to the MH TP handler **213**.

When it is determined that the corresponding MH TP includes an SMT section based upon the header in each of the inputted MH TP, the MH TP handler **213** parses the corresponding SMT section, so as to output the SI data within the parsed SMT section to the physical adaptation control signal handler **216**. However, this is limited to when the SMT is not encapsulated to IP datagrams.

Meanwhile, when the SMT is encapsulated to IP datagrams, and when it is determined that the corresponding MH TP includes an SMT section based upon the header in each of the inputted MH TP, the MH TP handler **213** outputs the SMT section to the IP network stack **220**. Accordingly, the IP network stack **220** performs IP and UDP processes on the inputted SMT section and, then, outputs the processed SMT section to the SI handler **240**. The SI handler **240** parses the inputted SMT section and controls the system so that the parsed SI data can be stored in the storage unit **290**.

The following corresponds to example of the fields that may be transmitted through the SMT.

A table_id field corresponds to an 8-bit unsigned integer number, which indicates the type of table section. The table_id field allows the corresponding table to be defined as the service map table (SMT).

A section_syntax_indicator field is a 1-bit field corresponding to an indicator defining the section format of the SLT. For example, the section format may correspond to MPEG long-form syntax.

A private_indicator field is a 1-bit field indicating whether or not the SMT follows (or is in accordance with) a private section.

A section_length field is a 12-bit field indicating the section length of the corresponding SMT.

A transport_stream_id field is a 16-bit field indicating a transport_stream identifier of a physical channel transmitting (or delivering) the corresponding SMT.

A version_number field is a 5-bit field indicating the version number of the corresponding SMT.

A current_next_indicator field is a 1-bit field indicating whether the data included in subsequent SMT sections are currently applicable.

A section_number field is an 8-bit field indicating the section number of the corresponding SMT.

A last_section_number field is also an 8-bit field indicating the last section number of the corresponding SMT.

An SMT_protocol_version field is an 8-bit field indicating the protocol version of the corresponding SMT section.

An ensemble_id field is an 8-bit unsigned integer field, which corresponds to an ID value associated to the corresponding MH ensemble. Herein, the ensemble_id field may be assigned with a value ranging from range '0x00' to '0x3F'. It is preferable that the value of the ensemble_id field is derived from the parade_id of the TPC data, which is carried from the baseband processor of MH physical layer subsystem. When the corresponding MH ensemble is transmitted through (or carried over) the primary RS frame, a value of '0' may be used for the most significant bit (MSB), and the remaining 7 bits are used as the parade_id value of the associated MH parade (i.e., for the least significant 7 bits). Alternatively, when the corresponding MH ensemble is transmitted through (or carried over) the secondary RS frame, a value of '1' may be used for the most significant bit (MSB).

A num_channels field is an 8-bit field, which specifies the number of virtual channels in the corresponding SMT section.

Meanwhile, the SMT according to the embodiment of the present invention provides information on a plurality of virtual channels using the 'for' loop statement.

A major_channel_num field corresponds to an 8-bit field, which represents the major channel number associated with the corresponding virtual channel. Herein, the major_channel_num field may be assigned with a value ranging from '0x00' to '0xFF'.

A minor_channel_num field corresponds to an 8-bit field, which represents the minor channel number associated with the corresponding virtual channel. Herein, the minor_channel_num field may be assigned with a value ranging from '0x00' to '0xFF'.

A short_channel_name field indicates the short name of the virtual channel. The service_id field is a 16-bit unsigned integer number (or value), which identifies the virtual channel service.

A service_type field is a 6-bit enumerated type field, which designates the type of service carried in the corresponding virtual channel as defined in Table 2 below.

TABLE 2

0x00	[Reserved]
0x01	MH__digital__television field: the virtual channel carries television programming (audio, video and optional associated data) conforming to ATSC standards.
0x02	MH__audio field: the virtual channel carries audio programming (audio service and optional associated data) conforming to ATSC standards.

TABLE 2-continued

0x03	MH__data__only__service field: the virtual channel carries a data service conforming to ATSC standards, but no video or audio component.
0x04 to 0xFF	[Reserved for future ATSC usage]

A virtual_channel_activity field is a 2-bit enumerated field identifying the activity status of the corresponding virtual channel. When the most significant bit (MSB) of the virtual_channel_activity field is '1', the virtual channel is active, and when the most significant bit (MSB) of the virtual_channel_activity field is '0', the virtual channel is inactive. Also, when the least significant bit (LSB) of the virtual_channel_activity field is '1', the virtual channel is hidden (when set to 1), and when the least significant bit (LSB) of the virtual_channel_activity field is '0', the virtual channel is not hidden.

A num_components field is a 5-bit field, which specifies the number of IP stream components in the corresponding virtual channel.

An IP_version_flag field corresponds to a 1-bit indicator. More specifically, when the value of the IP_version_flag field is set to '1', this indicates that a source_IP_address field, a virtual_channel_target_IP_address field, and a component_target_IP_address field are IPv6 addresses. Alternatively, when the value of the IP_version_flag field is set to '0', this indicates that the source_IP_address field, the virtual_channel_target_IP_address field, and the component_target_IP_address field are IPv4.

A source_IP_address_flag field is a 1-bit Boolean flag, which indicates, when set, that a source IP address of the corresponding virtual channel exist for a specific multicast source.

A virtual_channel_target_IP_address_flag field is a 1-bit Boolean flag, which indicates, when set, that the corresponding IP stream component is delivered through IP datagrams with target IP addresses different from the virtual_channel_target_IP_address. Therefore, when the flag is set, the receiving system (or receiver) uses the component_target_IP_address as the target_IP_address in order to access the corresponding IP stream component. Accordingly, the receiving system (or receiver) may ignore the virtual_channel_target_IP_address field included in the num_channels loop.

The source_IP_address field corresponds to a 32-bit or 128-bit field. Herein, the source_IP_address field will be significant (or present), when the value of the source_IP_address_flag field is set to '1'. However, when the value of the source_IP_address_flag field is set to '0', the source_IP_address field will become insignificant (or absent). More specifically, when the source_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '0', the source_IP_address field indicates a 32-bit IPv4 address, which shows the source of the corresponding virtual channel. Alternatively, when the IP_version_flag field value is set to '1', the source_IP_address field indicates a 128-bit IPv6 address, which shows the source of the corresponding virtual channel.

The virtual_channel_target_IP_address field also corresponds to a 32-bit or 128-bit field. Herein, the virtual_channel_target_IP_address field will be significant (or present), when the value of the virtual_channel_target_IP_address_flag field is set to '1'. However, when the value of the virtual_channel_target_IP_address_flag field is set to '0', the virtual_channel_target_IP_address field will become insignificant (or absent). More specifically, when the virtual_channel_target_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '0', the virtual_channel_target_IP_address field indicates a 32-bit target IPv4 address associated to the corresponding virtual channel. Alternatively, when the virtual_channel_target_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '1', the virtual_channel_target_IP_address field indicates a 64-bit target IPv6 address associated to the corresponding virtual channel. If the virtual_channel_target_IP_address field is insignificant (or absent), the component_target_IP_address field within the num_channels loop should become significant (or present). And, in order to enable the receiving system to access the IP stream component, the component_target_IP_address field should be used.

The EMT_activity_flag field indicates whether program table information including additional information associated with the corresponding ensemble exists. The program table information may describe information on an additional service that is not described in a service of the corresponding ensemble in the SMT. Herein, the program table information will be referred to as an extended service map table (EMT). And, the EMT will now be described in more detail. The receiving system (or receiver) uses the EMT_activity_flag field to determine whether an extended service map table (EMT), which describes additional service information associated with the corresponding SMT, is additionally transmitted in the broadcast signal. For example, when the EMT_activity_flag field value is equal to '1', the EMT is transmitted to the corresponding ensemble. On the other hand, when the EMT_activity_flag field value is equal to '0', the EMT is not transmitted to the corresponding ensemble.

Meanwhile, the SMT according to the embodiment of the present invention uses a 'for' loop statement in order to provide information on a plurality of components.

Herein, an RTP_payload_type field, which is assigned with 7 bits, identifies the encoding format of the component based upon Table 3 shown below. When the IP stream component is not encapsulated to RTP, the RTP_payload_type field shall be ignored (or deprecated).

Table 3 below shows an example of the RTP_payload_type.

TABLE 3

RTP_payload_type	Meaning
35	AVC video
36	MH audio
37 to 72	[Reserved for future ATSC use]

A component_target_IP_address_flag field is a 1-bit Boolean flag, which indicates, when set, that the corresponding IP stream component is delivered through IP datagrams with target IP addresses different from the virtual_channel_target_IP_address. Furthermore, when the component_target_IP_address_flag is set, the receiving system (or receiver) uses the component_target_IP_address field as the target IP address for accessing the corresponding IP stream component. Accordingly, the receiving system (or receiver) will ignore the virtual_channel_target_IP_address field included in the num_channels loop.

The component_target_IP_address field corresponds to a 32-bit or 128-bit field. Herein, when the value of the IP_version_flag field is set to '0', the component_target_IP_address field indicates a 32-bit target IPv4 address associated to the corresponding IP stream component. And, when the value of the IP_version_flag field is set to '1', the component_target_IP_address field indicates a 128-bit target IPv6 address associated to the corresponding IP stream component.

A port_num_count field is a 6-bit field, which indicates the number of UDP ports associated with the corresponding IP stream component. A target UDP port number value starts from the target_UDP_port_num field value and increases (or is incremented) by 1. For the RTP stream, the target UDP port number should start from the target_UDP_port_num field value and shall increase (or be incremented) by 2. This is to incorporate RTCP streams associated with the RTP streams.

A target_UDP_port_num field is a 16-bit unsigned integer field, which represents the target UDP port number for the corresponding IP stream component. When used for RTP streams, the value of the target_UDP_port_num field shall correspond to an even number. And, the next higher value shall represent the target UDP port number of the associated RTCP stream.

A component_level_descriptor( ) represents zero or more descriptors providing additional information on the corresponding IP stream component.

A virtual_channel_level_descriptor( ) represents zero or more descriptors providing additional information for the corresponding virtual channel.

An ensemble_level_descriptor( ) represents zero or more descriptors providing additional information for the MH ensemble, which is described by the corresponding SMT.

FIG. **18** illustrates an exemplary bit stream syntax structure of an MH audio descriptor according to the present invention.

When at least one audio service is present as a component of the current event, the MH_audio_descriptor( ) shall be used as a component_level_descriptor of the SMT. The MH_audio_descriptor( ) may be capable of informing the system of the audio language type and stereo mode status. If there is no audio service associated with the current event, then it is preferable that the MH_audio_descriptor( ) is considered to be insignificant (or absent) for the current event.

Each field shown in the bit stream syntax of FIG. **18** will now be described in detail.

A descriptor_tag field is an 8-bit unsigned integer having a TBD value, which indicates that the corresponding descriptor is the MH_audio_descriptor( ).

A descriptor_length field is also an 8-bit unsigned integer, which indicates the length (in bytes) of the portion immediately following the descriptor_length field up to the end of the MH_audio_descriptor( ).

A channel_configuration field corresponds to an 8-bit field indicating the number and configuration of audio channels. The values ranging from '1' to '6' respectively indicate the number and configuration of audio channels as given for "Default bit stream index number" in Table 42 of ISO/IEC 13818-7:2006. All other values indicate that the number and configuration of audio channels are undefined.

A sample_rate_code field is a 3-bit field, which indicates the sample rate of the encoded audio data. Herein, the indication may correspond to one specific sample rate, or may correspond to a set of values that include the sample rate of the encoded audio data as defined in Table A3.3 of ATSC A/52B.

A bit_rate_code field corresponds to a 6-bit field. Herein, among the 6 bits, the lower 5 bits indicate a nominal bit rate. More specifically, when the most significant bit (MSB) is '0', the corresponding bit rate is exact. On the other hand, when the most significant bit (MSB) is '0', the bit rate corresponds to an upper limit as defined in Table A3.4 of ATSC A/53B.

An ISO_639_language_code field is a 24-bit (i.e., 3-byte) field indicating the language used for the audio stream component, in conformance with ISO 639.2/B [x]. When a specific language is not present in the corresponding audio stream component, the value of each byte will be set to '0x00'.

FIG. **19** illustrates an exemplary bit stream syntax structure of an MH RTP payload type descriptor according to the present invention.

The MH_RTP_payload_type_descriptor( ) specifies the RTP payload type. Yet, the MH_RTP_payload_type_descriptor( ) exists only when the dynamic value of the RTP_payload_type field within the num_components loop of the SMT is in the range of '96' to '127'. The MH_RTP_payload_type_descriptor( ) is used as a component_level_descriptor of the SMT.

The MH_RTP_payload_type_descriptor translates (or matches) a dynamic RTP_payload_type field value into (or with) a MIME type. Accordingly, the receiving system (or receiver) may collect (or gather) the encoding format of the IP stream component, which is encapsulated in RTP.

The fields included in the MH_RTP_payload_type_descriptor( ) will now be described in detail.

A descriptor_tag field corresponds to an 8-bit unsigned integer having the value TBD, which identifies the current descriptor as the MH_RTP_payload_type_descriptor( ).

A descriptor_length field also corresponds to an 8-bit unsigned integer, which indicates the length (in bytes) of the portion immediately following the descriptor_length field up to the end of the MH_RTP_payload_type_descriptor( ).

An RTP_payload_type field corresponds to a 7-bit field, which identifies the encoding format of the IP stream component. Herein, the dynamic value of the RTP_payload_type field is in the range of '96' to '127'.

A MIME_type_length field specifies the length (in bytes) of a MIME_type field.

The MIME_type field indicates the MIME type corresponding to the encoding format of the IP stream component, which is described by the MH_RTP_payload_type_descriptor( ).

FIG. **20** illustrates an exemplary bit stream syntax structure of an MH current event descriptor according to the present invention.

The MH_current_event_descriptor( ) shall be used as the virtual_channel_level_descriptor( ) within the SMT. Herein, the MH_current_event_descriptor( ) provides basic information on the current event (e.g., the start time, duration, and title of the current event, etc.), which is transmitted via the respective virtual channel.

The fields included in the MH_current_event_descriptor( ) will now be described in detail.

A descriptor_tag field corresponds to an 8-bit unsigned integer having the value TBD, which identifies the current descriptor as the MH_current_event_descriptor( ).

A descriptor_length field also corresponds to an 8-bit unsigned integer, which indicates the length (in bytes) of the portion immediately following the descriptor_length field up to the end of the MH_current_event_descriptor( ).

An event_id field corresponds to a 16-bit field representing an identifier for identifying the corresponding event.

A current_event_start_time field corresponds to a 32-bit unsigned integer quantity. The current_event_start_time field represents the start time of the current event and, more specifically, as the number of GPS seconds since 00:00:00 UTC, Jan. 6, 1980.

A current_event_duration field corresponds to a 24-bit field. Herein, the current_event_duration field indicates the duration of the current event in hours, minutes, and seconds (wherein the format is in 6 digits, 4-bit BCD=24 bits).

A title_length field specifies the length (in bytes) of a title_text field. Herein, the value '0' indicates that there are no titles existing for the corresponding event.

The title_text field indicates the title of the corresponding event in event title in the format of a multiple string structure as defined in ATSC A/65C [x].

FIG. **21** illustrates an exemplary bit stream syntax structure of an MH next event descriptor according to the present invention.

The optional MH_next_event_descriptor( ) shall be used as the virtual_channel_level_descriptor( ) within the SMT. Herein, the MH_next_event_descriptor( ) provides basic information on the next event (e.g., the start time, duration, and title of the next event, etc.), which is transmitted via the respective virtual channel.

The fields included in the MH_next_event_descriptor( ) will now be described in detail.

A descriptor_tag field corresponds to an 8-bit unsigned integer having the value TBD, which identifies the current descriptor as the MH_next_event_descriptor( ).

A descriptor_length field also corresponds to an 8-bit unsigned integer, which indicates the length (in bytes) of the portion immediately following the descriptor_length field up to the end of the MH_next_event_descriptor( ).

An event_id field corresponds to a 16-bit field representing an identifier for identifying the corresponding event.

A next_event_start_time field corresponds to a 32-bit unsigned integer quantity. The next_event_start_time field represents the start time of the next event and, more specifically, as the number of GPS seconds since 00:00:00 UTC, Jan. 6, 1980.

A next_event_duration field corresponds to a 24-bit field. Herein, the next_event_duration field indicates the duration of the next event in hours, minutes, and seconds (wherein the format is in 6 digits, 4-bit BCD=24 bits).

A title_length field specifies the length (in bytes) of a title_text field. Herein, the value '0' indicates that there are no titles existing for the corresponding event.

The title_text field indicates the title of the corresponding event in event title in the format of a multiple string structure as defined in ATSC A/65C [x].

FIG. **22** illustrates an exemplary bit stream syntax structure of an MH system time descriptor according to the present invention.

The MH_system_time_descriptor( ) shall be used as the ensemble_level_descriptor( ) within the SMT. Herein, the MH_system time_descriptor( ) provides information on current time and date. The MH_system_time_descriptor( ) also provides information on the time zone in which the transmitting system (or transmitter) transmitting the corresponding broadcast stream is located, while taking into consideration the mobile/portable characteristics of the MH service data.

The fields included in the MH_system_time_descriptor( ) will now be described in detail.

A descriptor_tag field corresponds to an 8-bit unsigned integer having the value TBD, which identifies the current descriptor as the MH_system_time_descriptor( ).

A descriptor_length field also corresponds to an 8-bit unsigned integer, which indicates the length (in bytes) of the portion immediately following the descriptor_length field up to the end of the MH_system_time_descriptor( ).

A system_time field corresponds to a 32-bit unsigned integer quantity. The system_time field represents the current system time and, more specifically, as the number of GPS seconds since 00:00:00 UTC, Jan. 6, 1980.

A GPS_UTC_offset field corresponds to an 8-bit unsigned integer, which defines the current offset in whole seconds between GPS and UTC time standards. In order to convert GPS time to UTC time, the GPS_UTC_offset is subtracted from GPS time. Whenever the International Bureau of Weights and Measures decides that the current offset is too far in error, an additional leap second may be added (or subtracted). Accordingly, the GPS_UTC_offset field value will reflect the change.

A time_zone_offset_polarity field is a 1-bit field, which indicates whether the time of the time zone, in which the broadcast station is located, exceeds (or leads or is faster) or falls behind (or lags or is slower) than the UTC time. When the value of the time_zone_offset_polarity field is equal to '0', this indicates that the time on the current time zone exceeds the UTC time. Therefore, a time_zone_offset field value is added to the UTC time value. Conversely, when the value of the time_zone_offset_polarity field is equal to '1', this indicates that the time on the current time zone falls behind the UTC time. Therefore, the time_zone_offset field value is subtracted from the UTC time value.

The time_zone_offset field is a 31-bit unsigned integer quantity. More specifically, the time_zone_offset field represents, in GPS seconds, the time offset of the time zone in which the broadcast station is located, when compared to the UTC time.

A daylight_savings field corresponds to a 16-bit field providing information on the Summer Time (i.e., the Daylight Savings Time).

A time_zone field corresponds to a (5×8)-bit field indicating the time zone, in which the transmitting system (or transmitter) transmitting the corresponding broadcast stream is located.

FIG. **23** illustrates segmentation and encapsulation processes of a service map table (SMT) according to the present invention.

According to the present invention, the SMT is encapsulated to UDP, while including a target IP address and a target UDP port number within the IP datagram. More specifically, the SMT is first segmented into a predetermined number of sections, then encapsulated to a UDP header, and finally encapsulated to an IP header.

In addition, the SMT section provides signaling information on all virtual channel included in the MH ensemble including the corresponding SMT section. At least one SMT section describing the MH ensemble is included in each RS frame included in the corresponding MH ensemble. Finally, each SMT section is identified by an ensemble_id included in each section.

According to the embodiment of the present invention, by informing the receiving system of the target IP address and target UDP port number, the corresponding data (i.e., target IP address and target UDP port number) may be parsed without having the receiving system to request for other additional information.

For example, when the EMT_activity_flag field value in the SMT is equal to '1' (i.e., when information that EMT is to be transmitted is set up), the EMT linked to the SMT may be transmitted to the ensemble, in which the SMT is transmitted. Just as the SMT, the EMT may be transmitted to each ensemble by sections, which is the transmission unit of the EMT. Herein, the EMT may include a descriptor that describes the additional services transmitted by each ensemble. In the example shown in FIG. **24**, information are set to indicate that the EMT is being transmitted to the SMT of both Ensemble 1 and Ensemble K. Furthermore, it is also indicated that EMT section 1, which is linked to SMT Section 1, and EMT section M, which is linked to SMT Section K, are also transmitted to Ensemble 1 and Ensemble K, respectively. Contents of the EMT will hereinafter be described in detail.

FIG. **24** illustrates a flow chart for accessing a virtual channel using FIC and SMT according to the present invention.

More specifically, a physical channel is tuned (S**501**). And, when it is determined that an MH signal exists in the tuned physical channel (S**502**), the corresponding MH signal is demodulated (S**503**). Additionally, FIC segments are grouped from the demodulated MH signal in sub-frame units (S**504** and S**505**).

According to the embodiment of the present invention, an FIC segment is inserted in a data group, so as to be transmitted. More specifically, the FIC segment corresponding to each data group described service information on the MH ensemble to which the corresponding data group belongs. When the FIC segments are grouped in sub-frame units and, then, deinterleaved, all service information on the physical channel through which the corresponding FIC segment is transmitted may be acquired. Therefore, after the tuning process, the receiving system may acquire channel information on the corresponding physical channel during a sub-frame period. Once the FIC segments are grouped, in S**504** and S**505**, a broadcast stream through which the corresponding FIC segment is being transmitted is identified (S**506**). For example, the broadcast stream may be identified by parsing the transport_stream_id field of the FIC body, which is configured by grouping the FIC segments.

Furthermore, an ensemble identifier, a major channel number, a minor channel number, channel type information, and so on, are extracted from the FIC body (S**507**). And, by using the extracted ensemble information, only the slots corresponding to the designated ensemble are acquired by using the time-slicing method, so as to configure an ensemble (S**508**).

Subsequently, the RS frame corresponding to the designated ensemble is decoded (S**509**), and an IP socket is opened for SMT reception (S**510**).

According to the example given in the embodiment of the present invention, the SMT is encapsulated to UDP, while including a target IP address and a target UDP port number within the IP datagram. More specifically, the SMT is first segmented into a predetermined number of sections, then encapsulated to a UDP header, and finally encapsulated to an IP header. According to the embodiment of the present invention, by informing the receiving system of the target IP address and target UDP port number, the receiving system parses the SMT sections and the descriptors of each SMT section without requesting for other additional information (S**511**).

The SMT section provides signaling information on all virtual channel included in the MH ensemble including the corresponding SMT section. At least one SMT section describing the MH ensemble is included in each RS frame included in the corresponding MH ensemble. Also, each SMT section is identified by an ensemble_id included in each section. The SMT may include information indicating whether or not EMT, which transmits information on additional services, is transmitted to the corresponding ensemble.

Furthermore each SMT provides IP access information on each virtual channel subordinate to the corresponding MH ensemble including each SMT. Finally, the SMT provides IP stream component level information required for the servicing of the corresponding virtual channel.

Therefore, by using the information parsed from the SMT, the IP stream component belonging to the virtual channel requested for reception may be accessed (S**513**). Accordingly, the service associated with the corresponding virtual channel is provided to the user (S**514**).

If it is determined in Step **512** that the SMT includes information indicating that an EMT exists in the corresponding ensemble (S**515**: 'YES'), the EMT may be parsed in the corresponding ensemble so as to acquire the additional information (S**516**). Thereafter, by using the information acquired in Step **516**, the additional services, which cannot be described by the SMT, may be described, and the corresponding additional services may then be provided.

FIG. **25** illustrates an exemplary bit stream syntax structure of an EMT according to another embodiment of the present invention. The above-described SMT may describe a stream included in the service-providing virtual channel and channel information on the corresponding virtual channel. And, when the EMT_activity_flag field of the SMT is set up, an EMT, which is added to the SMT so as to describe the services that are to be provided, is transmitted.

Accordingly, the SMT may enable audio/video/data streams of the broadcast signal to be swiftly or quickly outputted from the receiving system. And, the EMT may either provide more detailed information on each virtual channel or describe the additional services.

Contents of the EMT will now be described in detail.

A table_id field is an 8-bit table identifier, which may be set up as an identifier for identifying the EMT. A section_syntax_indicator field corresponds to an indicator defining the section format of the EMT. For example, the section format may correspond to MPEG long-form syntax.

A Private_indicator field indicates whether or not the EMT follows (or is in accordance with) a private section. A reserved field corresponds to a non-designated field, and the value of the reserved field may, for example, be set to '1'.

A section_length field indicates the section length of the corresponding EMT. A transport_stream_id field represents a transport_stream indicator of a physical channel through which the corresponding EMT is being transmitted. Herein, also, a reserved field corresponds to a non-designated field, and the value of the reserved field may, for example, be set to '1'.

A version_number field indicates the version number of the corresponding EMT. A current_next_indicator field indicates whether the data included in subsequent EMT sections are currently applicable. A section_number field indicates the section number of the corresponding EMT.

A last_section_number field indicates the last section number of the corresponding EMT. An EMT_protocol_version field indicates the protocol version of the corresponding EMT section.

An ensemble_id field indicates an identification number of the ensemble which the EMT describes. A num_channels field indicates the number of channels included in the corresponding ensemble.

A major_channel_number field indicates the major channel number of the corresponding virtual channel, and a minor_ channel_number field indicates the minor channel number of the corresponding virtual channel.

A num_components field indicates the number of components included in the corresponding virtual channel.

The EMT may include a descriptor with respect to each level. For example, the EMT may include a descriptor for a component level (i.e., component_level_descriptor), a descriptor for an event level (i.e., event_level_descriptor), a descriptor for a virtual channel level (i.e., virtual_channel_level_descriptor), and a descriptor for an ensemble level (i.e., ensemble_level_descriptor).

More specifically, the component_level_descriptor may include information on the corresponding component.

A num_events field indicates a number of events included in an event.

And, the event_level_descriptor may include information on the corresponding event. Furthermore, the virtual_channel_level_descriptor and ensemble descriptor for each virtual channel may respectively include information on the corresponding virtual channel and the corresponding ensemble (i.e., ensemble_level_descriptor).

For example, the SMT describes basic information on a virtual channel of an ensemble, whereas the EMT may deliver (or transmit) additional service information or detailed information on additional service with respect to the virtual channel included in the corresponding ensemble via descriptors for each level. The descriptor for the EMT may include program guide information for the virtual channel, information associated with data broadcasting, information associated with interactive services, permission information associated with whether or not access to each virtual channel has been permitted, and so on.

Furthermore, a descriptor for an audio component among the virtual channel components shown in FIG. **18**, a descriptor for which the virtual channel describes a current/next event, as shown in FIG. **19** and FIG. **20**, and a descriptor describing a system time, as shown in FIG. **22**, may be included in the EMT so as to be transmitted and received.

Also, the above-described EMT (or SMT according to the second embodiment of the present invention) may be divided into constant units, such as section units. Herein, each of the section units may describe an ensemble.

When an SMT is received, the SI handler **240** of the receiving system shown in FIG. **1** may parse the SMT. Herein, when the SI handler **240** acquires information indicating that an EMT included in the SMT is being received, the SI handler **240** may receive the EMT from the IP network stack **220**. The SI handler **240** may include an EMT parser, which parses detailed information on the virtual channel included in the EMT and, then, stores the parsed information in the storage unit **290**. The MH management processor **200** reads the information parsed from the EMT from the storage unit **290**. Then, the MH management processor **200** delivers (or sends) the read information to the MH baseband processor **100** or the MH presentation processor **300**.

For example, when the information parsed from the EMT corresponds to information associated with a current or next event, or when the information parsed from the EMT corresponds to information associated with data broadcasting, the MH presentation processor **300** may control the system so that the information associated with an event or information associated with data broadcasting, which is delivered to the EMT, can be displayed to the user.

Furthermore, when the additional information parsed from the EMT corresponds to permission information on the storage or copying of specific broadcast data content, the MH management processor **200** may store or copy the broadcast data content received from a broadcast signal based upon the corresponding permission information.

For example, when the application manager activates an application for additional service, such as data broadcasting, and when the additional service information transmitted to the EMT is read from the storage unit **290**, the corresponding additional service information may be used to provide the additional service to the user.

Therefore, by using the information delivered to the above-described EMT (or SMT according to the second embodiment of the present invention), the receiving system (or receiver) may provide additional service information, which is associated with the corresponding ensemble, virtual channel, and component of the virtual channel, to the user along with the broadcast signal.

As described above, the present invention may provide a service transmitted through a virtual channel by using the SMT. The present invention may also identify that the EMT is being transmitted from the SMT. Furthermore, the present invention may acquire detailed additional information associated with the component included in the virtual channel, the event, the virtual channel, and the ensemble from the EMT.

Thereafter, the present invention may provide the detailed additional information acquired from the EMT as an additional service.

Therefore, the receiving system can provide additional service information associated with ensemble, virtual channel, and component of the virtual channel to the user together with the broadcasting signal by using the information transferred as SMT or EMT.

As described above, according to the present invention, the receiving system can provide the service transmitted to the virtual channel by using the SMT, and can identify that the EMT is transmitted from the SMT. Also, the receiving system can obtain detailed additional information of the component included in the virtual channel, the event, the virtual channel, and the ensemble, from the SMT or the EMT. Then, the receiving system can provide the detailed additional information as additional service or can control the received broadcasting contents by using permission information. A detailed example of transferring the permission information will be described below.

Meanwhile, the present invention relates to a receiving system that can receive and process both main service data and mobile service data. The present invention may respectively receive and process an A/V broadcast signal for mobile service and an A/V broadcast signal for main service through a mobile service data path and a main service data path of the receiving system. Hereinafter, according to the present invention, a receiving system that can receive and process both main service data and mobile service data will be referred to as a digital broadcast dual receiving system for simplicity.

The present invention relates to providing a program guide service of a mobile A/V broadcast program that is received through the mobile service data path by using program table information that is received through the main service data path in the dual receiving system. This embodiment is valid only when the same A/V broadcast signal is being simultaneously transmitted as main service data and mobile service data. This corresponds to the first embodiment of the present invention. According to the second embodiment of the present invention, in the dual receiving system, an A/V broadcast signal is received through one data path, and a data broadcast signal is received through another data path, thereby being process.

First Embodiment

According to the first embodiment of the present invention, a program guide service of a mobile A/V broadcast program that is received through the mobile service data path by using program table information that is received through the main service data path in the dual receiving system. In the first embodiment of the present invention, the program guide information is acquired from an event information table (EIT) among a plurality of program tables. More specifically, the program guide service of the main A/V broadcast program is provided using the EIT of the PSIP, and the program guide service of the mobile A/V broadcast program is provided using the ESG. Therefore, a receiving system that is not provided with an ESG engine may not be able to provide a program guide service for the corresponding mobile A/V broadcast program. Accordingly, the present invention relates to providing a program guide service for a corresponding mobile A/V broadcast program in a dual receiving system that does not include an ESG engine.

FIG. **26** illustrates a block view showing a structure of a receiving system according to a first embodiment of the present invention. Referring to FIG. **26**, the receiving system may include a host **600**, an MH baseband processor **611**, an MH management processor **612**, an A/V decoder **613**, a display module **614**, a main baseband processor **621**, a main management processor **622**, a table information engine **623**, and a table information database (DB) **624**. Hereinafter, a data path starting from the main baseband processor **611** to the MH management processor **612** will be referred to as the mobile service data path, and a data path starting from the main baseband processor **621** to the main management processor **622** will be referred to as the main service data path, for simplicity. Furthermore, since the processing of the A/V broadcast signal for main service that is received through the main service data path does not correspond to any aspect of the present invention, a detailed description of the related block will be omitted from the description of FIG. **26**.

The baseband processor **100** shown in FIG. **1** may be directly applied as the MH baseband processor **611** without modification. Also, the management processor **200** shown in FIG. **1** may be directly applied as the MH management processor **612** without modification. In this case, the ESG handler **270** and the ESG decoder **280** both shown in FIG. **1** may not be included in the MH management processor **612**. More specifically, an RS frame and an FIC received through a specific frequency and, then, demodulated and error-corrected by the MH baseband processor **611** are outputted to the MH management processor **612**. Herein, the RS frame includes an audio/video stream for mobile service.

The MH management processor **612** parses the FIC and stores the parsed result, which corresponds to FIC data. Also, the MH management processor **612** uses the FIC data and the SMT included in the RS frame, so as to extract an audio/video stream for mobile service requested for viewing from the corresponding RS frame, thereby outputting the extracted audio/video stream for mobile service to the A/V decoder **613**. Reference may be made to FIG. **1** for the FIC data and the SMT data, therefore detailed description of the same will be omitted from the description of FIG. **26** for simplicity. The A/V decoder **613** decodes each of the audio stream and the video stream and outputs the decoded streams to the display module **614**. The display module **614** provides the decoded audio and video signals inputted from the A/V decoder **613** to the user through a speaker and/or display screen.

Meanwhile, main service data received through a specific frequency and, then, demodulated and error-corrected by the main baseband processor **621** are outputted to the main management processor **622**. At this point, it is assumed that the A/V broadcast signal included in the main service data, which are received and processed by the main baseband processor **621**, and the A/V broadcast signal included in the mobile service data, which are received and processed by the MH baseband processor **611** are identical to one another (i.e., the same A/V broadcast signal). In other words, it is assumed that the A/V broadcast signal for main service is retransmitted as the A/V broadcast signal for mobile service in real-time. It is further assumed that the user has selected the A/V broadcast signal for mobile service, which is inputted and processed through the mobile service data path. The main management processor **621** extracts program table information from the error-corrected and received main service data. Then, the main management processor **621** outputs the extracted program table information to the table information engine **623**.

The table information engine **623** parses each table included in the program table information. Then, the table information engine **623** stores the parsed result in the table information database (DB) **624**. Herein, the program table information corresponds to at least one of the PSI/PSIP tables. For example, the table information engine **623** parses a program table required for the program guide service. Thereafter, the table information engine **623** stores the parsed result, which corresponds to the process guide information, to the table information DB **624**. According to the embodiment of the present invention, the EIT is parsed and the parsed result (i.e., EIT information) is stored in the table information DB **624**. The EIT corresponds to one of the program tables required for the program guide service. The EIT includes information on a virtual channel event (e.g., title, starting time, and ending time).

At this point, when the user selects the program guide service on the mobile service, the host **600** reads the program guide information associated with the mobile service from the table information DB **624**. Then, the host **600** outputs the read program guide information on the display screen through which the mobile service is currently being provided. In order to do so, the mobile A/V broadcast signal inputted and processed through the mobile service data path is required to be linked to the program guide information (i.e., EIT information) inputted and processed through the main service data path.

According to the embodiment of the present invention, the link information is included in at least one of the SMT and EMT in a descriptor format and then transmitted. Hereinafter, the link information configured in a descriptor format will be referred to as an event information location descriptor for simplicity. Herein, the event information location descriptor may be transmitted as one of an ensemble level descriptor, a virtual channel level descriptor, and a component level descriptor within at least one of the SMT and EMT. According to the first embodiment of the present invention, the event information location descriptor is transmitted as the virtual channel level descriptor.

FIG. **27** illustrates an exemplary syntax structure of an event information location descriptor event_information_location_descriptor( ) according to an embodiment of the present invention. Referring to FIG. **27**, the descriptor_tag field is an 8-bit field indicating that the corresponding descriptor is the event_information location_descriptor( ). The descriptor_length field is an 8-bit field indicating the byte-size length starting from the descriptor_length field to the end of the event_information_location_descriptor( ). The service_type field is a 6-bit field indicating the service type within the virtual channel that is currently providing mobile service. The source_id field is a 16-bit field indicating a program source connected to the corresponding virtual channel of the mobile service. Herein, the term "source" refers to any one specific source of image, text, data, and sound.

Based upon the control of the host **600**, the table information engine **623** uses the service_type field value and the source_id field value within the event information location descriptor so as to read the program guide information associated with the mobile service program that is currently being provided from the table information DB **624**. Subsequently, after reading the corresponding program guide information, the table information engine **623** processes the read program guide information and displays the processed information on a display screen through the display module **614**. At this point, the program guide information may be displayed along with the mobile A/V broadcast signal, or may be displayed separately.

FIG. **28** illustrates a flow chart showing a method of providing a program guide service according to an embodiment of the present invention. More specifically, while displaying the mobile A/V broadcast program inputted and processed through the mobile service data path (S**701**), when a request for a program guide service is inputted (S**702**), the host **600** activates the main management processor **622** (S**703**). Also, the host **600** verifies whether program guide information on the mobile service program that is currently being provided is stored in the table information DB **624** (S**704**). At this point, in order to search for the program guide information on the mobile service program that is currently being provided, the service_type field value and the source_id field value within the event information location descriptor may be used.

If it is verified that the program guide information on the mobile service program that is currently being provided is stored in the table information DB **624**, the corresponding program guide information is acquired from the table information DB **624** (S**705**). Thereafter, the acquired program guide information is displayed to the display screen (S**710**). Meanwhile, if it is verified, in step **704**, that the program guide information on the mobile service program that is currently being provided is not stored in the table information DB **624**, the host **600** activates the main baseband processor **621** (S**706**). Then, the main baseband processor **621** receives main service data including table information and the A/V broadcast signal, thereby demodulating and error-correcting the received main service data.

Subsequently, the program tables included in the error-corrected main service data are outputted to the table information engine **623** through the main management processor **622**. Based upon the control of the host **600**, the table information engine **623** uses the service_type field value and the source_id field value within the event information location descriptor so as to verify the mobile service program that is currently being provided (S**707**). Thereafter, the table information engine **623** parses the EIT associated with the corresponding mobile service among a plurality of program tables, thereby storing the parsed result in the table information DB (S**708**). Furthermore, the program guide information is acquired from the parsed EIT information (S**709**), thereby being displayed on the screen (**710**) Subsequently, after reading the corresponding program guide information, the table information engine **623** processes the read program guide information and displays the processed information on a display screen through the display module **614**. At this point, the program guide information may be displayed along with the mobile A/V broadcast signal, or may be displayed separately. According to the first embodiment of present invention, by using table information received through the main service data path in a digital broadcast dual receiving system, which does not include an ESG engine, the present may provided a program guide service associated with the mobile A/V broadcast program that is currently being provided to the user.

Second Embodiment

According to the second embodiment of the present invention, the dual receiving system receives an A/V broadcast signal through the main service data path and a data broadcast signal through the mobile service data path, thereby processing the received signals. Herein, the present invention relates to acquiring a data broadcast signal, which is bound with the main A/V broadcast signal being received and processed through the main service data path, from the mobile service data path.

FIG. **29** illustrates a block view showing a structure of a receiving system according to a second embodiment of the present invention. Referring to FIG. **29**, the receiving system may include a host **800**, an MH baseband processor **811**, an MH management processor **812**, a data decoder **813**, a data DB **814**, a main baseband processor **821**, a main management processor **822**, a main A/V decoder **823**, and a display module **824**. Hereinafter, a data path starting from the main baseband processor **811** to the MH management processor **812** will be referred to as the mobile service data path, and a data path starting from the main baseband processor **821** to the main management processor **822** will be referred to as the main service data path, for simplicity. Furthermore, since the processing of the A/V broadcast signal for mobile service that is received through the mobile service data path does not correspond to any aspect of the present invention, a detailed description of the related block will be omitted from the description of FIG. **29**.

The baseband processor **100** shown in FIG. **1** may be directly applied as the MH baseband processor **811** without modification. Also, the management processor **200** shown in FIG. **1** may be directly applied as the MH management processor **812** without modification. Referring to FIG. **29**, the main baseband processor **821** receives the main service data through a specific frequency. Then, the demultiplexed and error-corrected main service data are outputted to the main management processor **822**. Herein, the main service data include an A/V broadcast signal for main service and program table information. The main management processor **822** uses the program table information to identify an audio stream and a video stream from the main A/V broadcast signal. Then, the main management processor **822** outputs the identified audio stream and video stream to the main A/V decoder **823**. The main A/V decoder **823** decodes each of the audio stream and the video stream and outputs the decoded streams to the display module **824**. The display module **824** provides the decoded audio and video signals inputted from the main A/V decoder **823** to the user through a speaker and/or display screen.

The mobile service data received through a specific frequency and, then, demodulated and error-corrected by the MH baseband processor **811** are outputted to the MH management processor **812**. The MH management processor **812** extracts data for data broadcast service from the error-corrected mobile service data. Then, the MH management processor **812** outputs the extracted data to the data decoder **813**. According to the embodiment of the present invention, the data for data broadcast service is included in an IP packet format. The data decoder **813** filters the IP packet, so as to store only the data for data broadcast service in the data DB **814**. The host **800** reads the data for data broadcast service, which are bound with the main service A/V broadcast program that is currently being provided, from the data DB **814**, thereby displaying the read data to a display screen of the display module **824**.

At this point, information for identifying the data for data broadcast service bound with the main service A/V broadcast program, which is currently being provided, from all data for data broadcast service being inputted through the mobile service data path is required. According to the embodiment of the present invention, the above-mentioned identification information is included in a virtual channel table (VCT) in a descriptor format and then transmitted. Hereinafter, the identification information configured in a descriptor format will be referred to as a data byte location descriptor for simplicity. The data byte location descriptor includes information for identifying which main service A/V broadcast program currently being provided is bound to the mobile service data for data broadcasting, and also include IP information.

FIG. **30** illustrates an exemplary syntax structure of a data byte location descriptor data_byte_location_descriptor( ) according to an embodiment of the present invention. Referring to FIG. **30**, the descriptor_tag field is an 8-bit field indicating that the corresponding descriptor is the data_byte_location_descriptor( ). The descriptor_length field is an 8-bit field indicating the byte-size length starting from the descriptor_length field to the end of the data_byte_location_descriptor( ). The ensemble_id field is an 8-bit field indicating an identification value of an ensemble transmitting the mobile service data for data broadcasting. The major_channel_number field is an 8-bit field indicating a major channel number of a virtual channel transmitting the mobile service data for data broadcasting. The minor_channel_number field is also an 8-bit field indicating a minor channel number of a virtual channel transmitting the mobile service data for data broadcasting.

The IP_version_flag field corresponds to a 1-bit indicator. More specifically, when the value of the IP_version_flag field is set to '1', this indicates that a source_IP_address field and a virtual_channel_target_IP_address field are IPv6 addresses. Alternatively, when the value of the IP_version_flag field is set to '0', this indicates that the source_IP_address field and the virtual_channel_target_IP_address field are IPv4 addresses. The source_IP_address_flag field is a 1-bit Boolean flag. When the source_IP_address_flag field value is set to '1', this indicates that a source IP address of the corresponding virtual channel exist for a specific multicast source. The virtual_channel_target_IP_address_flag field is a 1-bit Boolean flag. When the virtual_channel_target_IP_address_flag field is set to '1', this indicates that the corresponding IP stream component is delivered through IP datagrams with target IP addresses different from the virtual_channel_target_IP_address.

The source_IP_address field corresponds to a 32-bit or 128-bit field. Herein, the source_IP_address field will be significant (or present), when the value of the source_IP_address_flag field is set to '1'. However, when the value of the source_IP_address_flag field is set to '0', the source_IP_address field will become insignificant (or absent). More specifically, when the source_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '0', the source_IP_address field indicates a 32-bit IPv4 address, which shows the source of the corresponding virtual channel. Alternatively, when the IP_version_flag field value is set to '1', the source_IP_address field indicates a 128-bit IPv6 address, which shows the source of the corresponding virtual channel.

The virtual_channel_target_IP_address field also corresponds to a 32-bit or 128-bit field. Herein, the virtual_channel_target_IP_address field will be significant (or present), when the value of the virtual_channel_target_IP_address_flag field is set to '1'. However, when the value of the virtual_channel_target_IP_address_flag field is set to 'o', the virtual_channel_target_IP_address field will become insignificant (or absent). More specifically, when the virtual_channel_target_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '0', the virtual_channel_target_IP_address field indicates a 32-bit target IPv4 address associated to the corresponding virtual channel. Alternatively, when the virtual_channel target_IP_address_flag field value is set to '1', and when the IP_version_flag field value is set to '1', the virtual_channel_target_IP_address field indicates a 64-bit target IPv6 address associated to the corresponding virtual channel.

The content_type field is an 8-bit field indicating a content type of the mobile service data for data broadcasting. The content_name field indicates the name of the content of the mobile service data for data broadcasting. The content_id field is a 16-bit field indicating an identification value for identifying mobile service data for data broadcasting, which configure a single content. More specifically, the data byte location descriptor may be included in a program table (e.g., VCT) describing channel information of a main service A/V broadcast signal, which is received and processed through the main service data path, so as to be received.

The host **800** refers to the data byte location descriptor data_byte_location_descriptor( ) within the VCT, in order to identify the mobile service data for data broadcasting bound to the main service A/V broadcast signal, which is currently being received and processed. Then, the host **800** controls the receiving system so that the identified mobile service data can be displayed on a display screen. At this point, the ensemble_id field, the major_channel_number field, and the minor_channel_number field the within the data_byte_location_descriptor( ) may be used as identification information for identifying which main service A/V broadcast program currently being provided is bound to the mobile service data for data broadcasting. Furthermore, the IP_version_flag field, the source_IP_address_flag field, the virtual_channel_target_IP_address field, the source_IP_address field, and the virtual_channel_target_IP_address field may be used as IP information for receiving the mobile service data for data broadcasting, which is bound to the main A/V broadcast signal.

FIG. **31** illustrates a flow chart showing a method of providing a data broadcasting service according to an embodiment of the present invention. More specifically, while displaying the main A/V broadcast program inputted and processed through the main service data path (S**901**), when a request for executing data broadcasting is inputted (S**902**), the host **800** activates the MH management processor **812** (S**903**). Also, the host **800** verifies whether mobile service data for data broadcasting is stored in the data DB **814** by using an identification information included in the data byte location descriptor, which is included in a program table (e.g., VCT) of the main service data and received (S**904**).

If it is verified that the mobile service data for data broadcasting, which is bound to the main A/V broadcast signal currently being broadcasted, is stored in the data DB **814**, the corresponding mobile service data is acquired from the data DB **814** by using the IP information within the data byte location descriptor (S**905**). Then, the acquired mobile service data (or data casting information) is displayed on the display screen (S**910**). Herein, the mobile service data for data broadcasting may be displayed on the display screen along with the main A/V broadcast signal, or be individually displayed on the display screen. Meanwhile, if it is verified that the mobile service data for data broadcasting, which is bound to the main A/V broadcast signal currently being broadcasted, is not stored in the data DB **814**, the host **800** activates the MH baseband processor **811** so as to receive the mobile service data for data broadcasting through the mobile service data path, thereby demodulating and error-correcting the received mobile service data (S**906**).

Thereafter, the host **800** verifies whether the mobile service data for data broadcasting, which is bound to the main A/V broadcast signal currently being broadcasted, is being received by using the identification information within the data byte location descriptor, which is included in the VCT and then received. Accordingly, if it is determined that the mobile service data for data broadcasting is being received, the host **800** filters only the corresponding mobile service data for data broadcasting (or data casting information) by using the IP information within the data byte location descriptor (S**907**). The filtered mobile service data for data broadcasting are then stored in the data DB **814** (S**908**). Thereafter, the stored mobile service data for data broadcasting (or data casting information) are outputted to the display module (S**909**), thereby being displayed on the display screen (S**910**). Herein, the mobile service data for data broadcasting may be displayed on the display screen along with the main A/V broadcast signal, or be individually displayed on the display screen.

As described above, the receiving system and the data processing method according to the second embodiment of the present invention may receive data for data broadcasting service, which are received and processed through the main service data path and which are bound to the main A/V broadcast program, through the mobile service data path, thereby providing a data broadcasting service to the user.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A method of processing broadcast data in a broadcast receiver, the method comprising:

receiving a transmission frame including a plurality of sub-frames, the transmission frame comprising mobile service data, a first signaling information table including access information of the mobile service data, a plurality of known data sequences, transmission parameter channel (TPC data) and fast information channel (FIC) segments delivered through an FIC;

demodulating the received transmission frame;

decoding the FIC segments and the TPC data of the demodulated transmission frame,

wherein the FIC segments are deinterleaved on a sub-frame basis, wherein the FIC segments include information for rapid mobile service acquisition,

wherein the TPC data include FIC version information and information indicating a current sub-frame number within the transmission frame, and

wherein one of the FIC segments and the TPC data are positioned between a first known data sequence and a second known data sequence among the plurality of known data sequences;

wherein each of the FIC segments comprises a 35-byte segment payload and a 2-byte segment header including error indication information;

building a Reed Solomon (RS) frame including the mobile service data of the demodulated transmission frame, the RS frame belonging to an ensemble including the first signaling information table;

extracting the first signaling information table from the ensemble; and

obtaining an IP datagram of the mobile service data using the first signaling information table.

2. The method of claim **1**, wherein the error indication information indicates whether the corresponding FIC segment contains an error.

3. The method of claim **1**, further comprising:

receiving main service data and a second signaling information table through a main service data path; and

extracting link information from at least the first signaling information table or the second signaling information table, the link information giving link information between the mobile service data and the main service data.

4. The method of claim 3, further comprising receiving additional information of the mobile service data through the main service data path.

5. A broadcast receiver comprising:

a tuner for receiving a transmission frame including a plurality of sub-frames, the transmission frame comprising mobile service data, a first signaling information table including access information of the mobile service data, a plurality of known data sequences, transmission parameter channel (TPC data) and fast information channel (FIC) segments delivered through an FIC;

a demodulator for demodulating the received transmission frame; and

a signaling decoder for decoding the FIC segments and the TPC data of the demodulated transmission frame,

wherein the FIC segments are deinterleaved on a sub-frame basis,

wherein one of the FIC segments and the TPC data are positioned between a first known data sequence and a second known data sequence among the plurality of known data sequences;

wherein the FIC segments include information for rapid mobile service acquisition,

wherein the TPC data include FIC version information and information indicating a current sub-frame number within the transmission frame, and

wherein each of the FIC segments comprises a 35-byte segment payload and a 2-byte segment header including error indication information;

a Reed Solomon (RS) frame decoder for building an RS frame including the mobile service data of the demodulated transmission frame, the RS frame belonging to an ensemble including the first signaling information table; and

a handler for extracting the first signaling information table from the ensemble broadcast signal and obtaining an IP datagram of the mobile service data using the first signaling information table.

6. The broadcast receiver of claim 5, wherein the error indication information indicates whether the corresponding FIC segment contains an error.

7. The broadcast receiver of claim 5, wherein the tuner receives main service data and a second signaling information through a main service data path.

8. The broadcast receiver of claim 7, wherein the handler extracts link information from at least the first signaling information table or the second signaling information table, the link information giving link information between the mobile service data and the main service data.

9. The broadcast receiver of claim 8, wherein the tuner receives additional information of the mobile service data through the main service data path.

10. A method of processing broadcast data in a broadcast transmitter, the method comprising:

performing, by a Reed Solomon (RS) encoder, RS encoding and Cyclic Redundancy Check (CRC) encoding on mobile service data to form an RS frame belonging to an ensemble including and a first signaling information table including access information of the mobile service data;

encoding transmission parameter channel (TPC) data and fast information channel (FIC) segments delivered through an FIC,

wherein the FIC segments are interleaved on a sub-frame basis,

wherein the FIC segments include information for rapid mobile service acquisition,

wherein the TPC data include FIC version information and information, and

wherein each of the FIC segments comprises a 35-byte segment payload and a 2-byte segment header including error indication information;

wherein one of the FIC segments and the TPC data are positioned between a first known data sequence and a second known data sequence among the plurality of known data sequences;

mapping data of the RS frame into a plurality of groups, wherein each of the groups includes a portion of data included in the RS frame, a plurality of known data sequences, one of the FIC segments and the TPC data;

transmission frame comprising data of the plurality of groups,

wherein the transmission frame includes a plurality of sub-frames, and

wherein the TPC data further include information for indicating a current sub-frame number within the transmission frame broadcast signal including the plurality of groups.

11. The method of claim 10, wherein the error indication information indicates whether the corresponding FIC segment contains an error.

12. The method of claim 10, further comprising:

transmitting main service data and a second signaling information table through a main service data path, wherein link information is included in at least the first signaling information table or the second signaling information table, the link information giving link information between the mobile service data and the main service data.

13. The method of claim 12, further comprising transmitting additional information of the mobile service data through the main service data path.

14. A broadcast transmitter comprising:

an RS frame encoder for performing Reed Solomon (RS) encoding and Cyclic Redundancy Check (CRC) encoding on mobile service data to form an RS frame belonging to an ensemble including a first signaling information table including access information of the mobile service data;

a signaling encoder for encoding transmission parameter channel (TPC) data and fast information channel (FIC) segments delivered through an FIC,

wherein the FIC segments are interleaved on a sub-frame basis,

wherein the FIC segments include information for rapid mobile service acquisition,

wherein the TPC data include FIC version information and information, and

wherein one of the FIC segments and the TPC data are positioned between a first known data sequence and a second known data sequence among the plurality of known data sequences;

wherein each of the FIC segments comprises a 35-byte segment payload and a 2-byte segment header including error indication information;

a group formatting means for mapping data of the RS frame into a plurality of groups, wherein each of the groups includes a portion of data included in the RS frame, a plurality of known data sequences, one of the FIC segments and the TPC data; and a transmitting means for transmitting a transmission frame comprising data of the plurality of groups,

wherein the transmission frame includes a plurality of sub-frames, and

wherein the TPC data further include information for indicating a current sub-frame number within the transmission frame.

15. The broadcast transmitter of claim **14**, wherein the error indication information indicates whether the corresponding FIC segment contains an error.

16. The broadcast transmitter of claim **14**, wherein the transmitting means transmits main service data and a second signaling information table through a main service data path, wherein link information is included in at least the first signaling information table or the second signaling information table, the link information giving link information between the mobile service data and the main service data.

17. The broadcast transmitter of claim **16**, wherein the transmitting means transmits additional information of the mobile service data through the main service data path.

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